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S. HRG. 102-810

S. 2297, THE LAND REMOTE SENSING POLICY ACT OF 1992

PL6-29

HEARING
BEFORE THE
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY,
AND SPACE
OF THE
COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE
ONE HUNDRED SECOND CONGRESS
SECOND SESSION

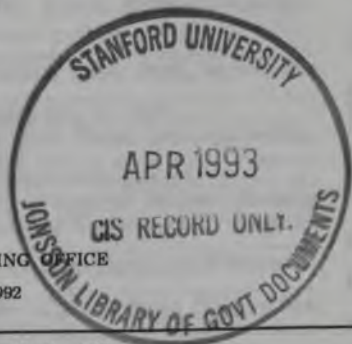
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S. 2297, THE LAND REMOTE SENSING POLICY ACT OF 1992

WEDNESDAY, MAY 6, 1992

**U.S. SENATE,
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY,
AND SPACE OF THE COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION,
Washington, DC.**

The subcommittee met, pursuant to notice, at 9:35 a.m., in room SR-253 of the Russell Senate Office Building, Hon. Albert Gore, Jr. (chairman of the subcommittee) presiding.

Staff members assigned to this hearing: Steven O. Palmer, senior professional staff member; and Louis C. Whitsett, minority staff counsel.

OPENING STATEMENT OF SENATOR GORE

Senator GORE. The subcommittee will come to order. Today, our subcommittee convenes to examine the condition of the Land Remote Sensing Satellite Program, otherwise known as Landsat. More importantly, the subcommittee will focus its attention on options for preserving Landsat and enhancing it for the future.

It has been 20 years since the first Landsat satellite was launched. As a technical endeavor, the program has been an unqualified success. Today, Landsats 4 and 5 continue to gather data on the Earth's changing land masses, having far outlasted their expected useful lives. In total, five Landsat spacecraft have generated a long-term data set of tremendous value, particularly to researchers attempting to understand environmental change on our planet.

It was the decision to commercialize Landsat in 1984, however, that placed the future of this satellite program in question. Quite simply, the U.S. Government should not have initiated the commercialization of Landsat in the manner in which it was undertaken. That much seems to be abundantly clear at this point. I have said for years that that was a nonsensical decision.

Our experience during the past 8 years of commercialization has proven that change is now needed. For example, the number of images taken today by the Landsat spacecraft has declined precipitously when compared to images taken in the pre-1984 era. Of course, this is due largely to the cost Landsat users must be charged in the commercial marketplace.

A Landsat scene that cost several hundred dollars in the early 1980's now costs more than \$4,000. As a result, naturally, the number of researchers using Landsat data has fallen off dramatically, with the possible exception of researchers employed by corporations

the size of Exxon or McDonald's who want to look for new commercial locations.

Right to the point, Landsat commercialization was poorly conceived. And the manner in which it has been carried out has been, to say the least, less than impressive. Take for example the experience of the environmental research community, which was largely ignored in the development of the 1984 Landsat Act. The reality is that most global change scientists have come to consider Landsat data totally inaccessible because of its impossibly high price and proprietary restrictions.

What an ironic situation we have created. We are willing to spend billions of taxpayer dollars on brand new environmental satellite systems—and I think we should. I strongly support them. And yet, we have been unwilling to provide the fantastic data that we already have collected to the research community at a cost that they can afford. It is really absurd.

The bottom line is that, given the critical data baseline that Landsat provides, we must make every effort to improve the delivery of this data to global change researchers.

I am pleased there seems to be a growing consensus among academic, military, governmental, and environmental interests on the need to move forward with the Landsat program, both to correct the mistakes of commercialization as well as to provide for the development and launch of the Landsat 7 spacecraft. Taking these steps will ensure continued collection and widespread dissemination of Landsat data into the next century, after which the first of NASA's Earth Observing System spacecraft is expected to be in operational orbit.

Before concluding this opening statement, I want to strongly commend my colleague, the ranking member of this subcommittee, Senator Larry Pressler, for his continued interest and outstanding leadership where the Landsat program is concerned. Senator Pressler's legislation has been the focus of a great deal of discussion. And while I have not yet endorsed it, I welcome its philosophical approach of providing Landsat data to the greatest number of users at the lowest possible cost. We will, of course, have a great deal of discussion about Senator Pressler's proposal here today.

I look forward to hearing from our three panels. We have a great deal of ground to cover, as each witness will provide an important perspective on the Landsat program. Consequently, I am going to ask that our witnesses stay within the 5 minutes allocated to each for testimony. I know that will be difficult because it is a complex subject, but it is essential simply because of the number of witnesses we have. And I am going to ask the staff to use the timer, and these lights are not difficult to interpret.

The written statement of each witness will be included in the record in its entirety, and I can assure each of you that your full written statement will be used in future deliberations on any legislation related to the Landsat system. We will now hear from the chairman, Senator Hollings.

OPENING STATEMENT OF SENATOR HOLLINGS

The CHAIRMAN. In 1984, after nearly a decade of success with the Government-operated Satellite Remote Sensing Program, the deci-

sion was made to commercialize Landsat. This step was taken as a part of the then-prevailing philosophy that the Federal Government should no longer be in the business of operating nonessential programs.

Unfortunately, the decision to commercialize has meant that few, if any, interested parties can afford to acquire Landsat data. Where State and local governments, universities, and nonprofit groups once were able to use Landsat data for research or resource exploration, now only the largest corporations can afford the \$4,400 it costs just for one Landsat image.

Quite simply, commercialization has had a chilling effect on the number of data users. While the cost of data increased, the level of taxpayer subsidy to the Landsat contractor continued unabated. The end result is that the American people now find themselves in a position of having to pay twice for Landsat data, once through the subsidy to operate the program and build future spacecraft, and again for any data acquisitions. Obviously, the time has come to find some solution to this policy.

Today's hearing will enable this committee to gain a better understanding of how this situation developed, as well as some possibilities for correcting it. In that regard, I welcome one particular witness, Dr. John Jensen, from the University of South Carolina. Dr. Jensen, who is the Carolina Research Professor in the Geography Department at USC, is a nationally recognized expert in the field of remote sensing. We are fortunate to receive his testimony today, as the committee will benefit from his expertise and insight with respect to the Landsat program.

Thank you, Mr. Chairman.

Senator GORE. Thank you, Mr. Chairman. Now, it is my pleasure to acknowledge and recognize at this point our ranking member, Senator Pressler.

OPENING STATEMENT OF SENATOR PRESSLER

Senator PRESSLER. Thank you very much, Mr. Chairman, for holding this important hearing. For too long, we have pushed the Landsat policy debate to side. Thanks to your leadership, Senator Gore, today we are considering legislation which will provide a comprehensive Landsat management plan to serve this Nation into the next century.

Mr. Chairman, I notice with interest in the Washington Post of yesterday an ad against this legislation, which concludes that we should consider all the facts. So, that is what we are here today to do. And we hope that EOSAT will give us several facts.

The Land Remote Sensing Commercialization Act of 1984 was founded on the belief that a large commercial market for Landsat data would develop, and commercial demand would then support the development, launching, and operation of future Landsat satellites.

The predictions of commercial viability have not come true. We now have 8 years of experience to prove commercialization does not work. It was clear to many of us back in the early 1980's that commercialization would not work. However, the only other politically viable alternative was to terminate the program. That would have been an even more tragic mistake.

I have to say that, in retrospect, my expectation that commercialization would fail has come true. My overriding concern was to protect the technology. Fortunately, that has been preserved. As those of us who in 1984 urged alternatives to commercialization predicted, it is clear that since that time we have spent millions of dollars in subsidies to prop up a flawed commercial enterprise.

And what has been the result of the commercialization experiment? It has driven scientific and global change research users out of the Landsat data market. We now tax private businesses to fund Landsat, then turn around and charge them again to purchase the data. The Federal Government itself subsidizes a monopoly, and then pays again to use the data it produces.

This is a system that needs to be changed. I am told that the photos are so expensive for nonprofit groups, and for anybody, that they are almost unusable. And with the upcoming studies of warming of the Earth and so forth, I met with several of the people from several environmental groups that are supporting this legislation from across the United States.

For these reasons, I have introduced legislation to restore Landsat's emphasis on availability to scientific researchers and other public interest users. S. 2297 returns the responsibility of managing the Landsat program to the Federal Government. In this way, the objective of this tax-supported system will be to maximize the total benefits to the public good, rather than to maximize the profits of a subsidized monopoly.

This legislation will accomplish this goal through the establishment of specific data dissemination and pricing objectives. This bill will give back to the Government the ownership of an all unenhanced Landsat data, and will prohibit exclusive marketing rights from being extended to any contractor. This will mean Landsat data will be treated in much the same way as weather or census data, ensuring competition among many diverse groups in the dissemination of Landsat data.

The current situation provides real economic incentive for a monopoly contractor to favor its own needs over those of other competing, value-added companies. S. 2297 provides that no exclusive marketing rights are extended to any contractor. This section will ensure that a monopolist will not take advantage of its position.

In conclusion, Mr. Chairman, the data pricing foundation of my legislation is based on a policy of nondiscriminatory access to all Landsat data. S. 2297 provides that unenhanced Landsat data would be available to all users participating in global change research and other activities at the marginal cost of fulfilling a specific data request.

This single pricing structure for unenhanced data will result in an increase in the amount of all land remote sensing research. Furthermore, it will maximize commercial opportunities for the value-added industry to provide data processing and analysis services.

I recognize that some have suggested we adopt a multitiered pricing scheme. The problem with this suggestion is that it is difficult to define exactly what is commercial research and what is scientific research. This would make enforcement of a multitiered pricing scheme difficult at best, impossible at worst.

I understand that the administration today will ask us to be silent on data policy and allow NASA to negotiate an arrangement. Let me just say that I was pleased to see the Office of Management and Budget Circular No. A130 published last Wednesday, finally. These proposed regulations on dealing with federally produced data are consistent with the intent of my legislation.

However, there is no guarantee that a negotiated agreement will be reached that is in line with the intent of circular A130. Therefore, it is imperative that we establish a single-tiered, marginal cost data policy, for price is the key to broader Landsat data availability.

Another primary component of S. 2297 is the transfer of operational responsibility from the Department of Commerce to NASA and the Department of Defense. This transfer would combine the technical and management competence of NASA and the Department of Defense to ensure the comprehensive, long-term acquisition of Landsat data which is vital to the national defense, global environmental change research, and civilian operational use.

Finally, S. 2297 will ensure that Landsat data is routinely acquired around the world and provided to the National Satellite Land Remote Sensing Archive for use by current and future generations. Providing data at marginal cost will result in heavy tasking, providing a larger data stream to build our Nation's archive.

Mr. Chairman, thank you for indulging me. I look forward to today's witnesses.

Senator GORE. Well, thank you again, Senator Pressler. Our first panel is already seated. I would like to introduce them at this point. Dr. Lennard A. Fisk is Associate Administrator of the Office of Space, Science, and Applications with NASA here in Washington. Mr. Martin C. Faga is Assistant Secretary for Space with the Department of the Air Force at the Pentagon here in Washington—a long-time friend. Welcome back.

Dr. Dallas Peck, Director of the U.S. Geological Survey with the Department of the Interior, along with our first two witnesses, has appeared here before, as has Dr. Peck and Dr. Fisk. Mr. James J. Frelk, Director of the Office of Space Commerce with the Department of Commerce in Washington, DC.

Let me apologize to our witnesses and guests for the fact that our sound system seems to be remotely sensing some police walkie-talkies. And occasionally that occurs because we do not have a so-called shielded system here, but we will just make the best of it.

Let me remind you that we are going to try to abide by the 5-minute testimony rule. Dr. Fisk, if you could begin, please do.

STATEMENT OF DR. LENNARD A. FISK, ASSOCIATE ADMINISTRATOR, OFFICE OF SPACE SCIENCE AND APPLICATIONS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. FISK. Thank you very much, Senator. I will submit my full testimony for the record. It is a pleasure to be here to talk with the subcommittee about our plans for implementing the Landsat program and to comment on S. 2297.

We feel, as you do, that Landsat is a very valuable, historical record. It is going to be very important to us for the Mission to

Plant Earth, and we anticipate the demand for Landsat data to increase substantially as we pursue global change research over the coming decades. And we are committed to having a successful Landsat program and to making the data widely available, and to meeting the needs of all the users.

Now, as you know, the President has renewed the U.S. commitment to maintain continuity in the Landsat program, and the responsibility has been passed to NASA and DOD, and we have a management plan in effect that we will discuss with you today. But let me first comment, if I may, on S. 2297.

This is, in our judgment, a very important piece of legislation. It provides NASA and the Department of Defense with the authority and the flexibility to proceed expeditiously in the Landsat program. And we view this legislation as a very constructive thing to do.

There are, however, two areas which we would like to comment on for modifications, and Senator Pressler noted them in his opening remarks. First is that, with regard to Landsat 6, we would recommend that the legislation be less directive regarding the possible transfer of agency responsibilities. This is simply a pragmatic request. These negotiations with current contracts will be done by negotiation, and that mandating a solution in the legislation could have some unwanted fiscal consequences for us, and we look for flexibility there.

Second, with regard to the Landsat data, we would also recommend that the legislative provisions regarding specific pricing and dissemination policies be deleted. I do not think there is any question about our goals on this thing, and they are to maintain data continuity for global change research, national security, and other purposes; ensure that Federal data needs are met; foster U.S. leadership in remote sensing; encourage future commercial opportunities. And in our judgment, in order to do that, price should not be a barrier in the use of Landsat 7 data for global change or environmental research, national security, or other Federal Government purposes.

Therefore, as a first principle, we are planning to provide data for global change research and the marginal cost of fulfilling a specific user request. And it is our judgment that this is necessary to achieve the Federal purposes for which the Landsat program is to be conducted.

And as regards Landsats 1 through 6, NASA will seek to negotiate an agreement such that the data from 1 through 6 are made available in a manner similar to the arrangements for data access and acquisition for Landsat 7.

Now, for other non-Federal users of Landsat, we believe that unenhanced Landsat data should be treated just like any other federally produced data. And, thus, we do not believe that the Landsat data should be treated as a special part of legislation. Instead, we would like to see it dealt with through the broader regulatory process to be governed by the Office of Management and Budget's Circular A130 on the management of Federal information resources. This is the circular that applies to all federally produced data.

And, as you noted on April 29, OMB published for comment a revision to that, and this revision would set a standard for Federal

agency user charges for Federal information products simply at a level sufficient to recover the cost of dissemination.

Now let me just turn briefly to the Landsat management plan. As you are aware, the management plan essentially defines the roles of DOD and NASA—NASA representing the U.S. global change research community, and DOD the national security community.

The project is essentially to be split evenly between the two agencies, and there is to be a close working relationship, each agency participating in the other's activities to ensure the technical details and other things are well coordinated. To that end there is a Landsat coordination group which will be jointly chaired by the two agencies.

The goals for the follow-on Landsat, Landsat 7, are simple. We want to maintain data continuity. And to that end, Landsat 7 will have the same capabilities as Landsat 6, and will provide continuities through Landsats 4, 5, 6, and then 7. The system will be operated in such a way as to make the data available to all U.S. civilian, national security, and private sector users.

NASA's role in this is to have the lead responsibility for the development and operation of the ground system, including data processing, archiving, distribution, user support, mission operations, and management. And the ground system will be developed so as not to preclude private sector participation.

In summary, I would like to reiterate NASA's commitment to the Landsat program. NASA and the Department of Defense have developed a strong partnership. We have our goals well established. And we are moving ahead now to meet the administration's goal of continuation of Landsat type data.

Thank you very much.

[The prepared statement of Dr. Fisk follows:]

PREPARED STATEMENT OF DR. LENNARD A. FISK

I am pleased to have the opportunity to appear before the Subcommittee today to testify on S. 2297, the Land Remote Sensing Policy Act of 1992 and to discuss the status of our plans for implementing the Landsat program. NASA and DoD are moving ahead rapidly on plans to implement a Landsat program that meets our common goal of data continuity and the advancement of remote sensing technology. We believe we have defined an approach which will meet these goals, as well as assuring the continuation of the system in the future.

The Landsat program represents a valuable historical and on-going data base that will play an extremely important role in NASA's Mission to Planet Earth, and the broader U.S. Global Change Research Program. NASA anticipates that demand for Landsat data for global change research as well as for national security and other public and private purposes will increase greatly in coming years. We are strongly committed to ensuring that the Landsat program is successfully continued, that Landsat data will be made widely available, and that it will meet the needs of all users.

Because of the value of the program to a broad community of users, in February 1992 the President renewed the U.S. commitment to seek to maintain the continuity of Landsat-type data. The President's National Space Policy Directive 5 (NSPD 5) on Landsat Remote Sensing Strategy specifies that NASA and DoD will be responsible for developing and launching Landsat 7 and defining alternatives for maintaining data continuity beyond Landsat 7. NSPD 5 requires NASA and DoD to develop a Management Plan for the Landsat program. This plan has been completed, and has been reviewed by the National Space Council. I will discuss the key features of the plan and the status of our efforts to implement the program shortly. But first, I would like to address our position on S. 2297, the legislation offered by this committee to continue the Landsat program.

S. 2297 is an important piece of legislation that will help assure the future of the Landsat program. The bill provides NASA and the Department of Defense with the authority and the flexibility to proceed expeditiously with the Landsat program. Like its counterpart in the House of Representatives, H.R. 3614, the bill represents a constructive approach to continuation of the Landsat program. NASA and DoD have been in touch with the Subcommittee staff, and have provided input to reflect the Administration's approach to developing the Landsat program. As the legislation proceeds, we look forward to working with the Subcommittee to provide any information and assistance desired. It is important to note that while NASA and DoD are moving ahead to continue the Landsat program, how the program is structured and operated will depend in part upon amendments to the existing law governing land remote sensing, such as those proposed in S. 2297 and H.R. 3614. NASA and DoD will work with the subcommittee to assure that Congressional direction is reflected in the program's implementation.

In general, the Administration agrees with the approach toward Landsat program management outlined in S. 2297. There are, however, two areas where we would like some modification.

First, with regard to Landsat 6, we recommend that the legislation be less directive regarding the possible transfer of agency responsibilities and regarding changes in existing contracts for the operations and marketing of Landsat data. While the Administration will almost certainly seek some modifications in current contracts, these are properly achieved through negotiations. Mandating a solution in legislation could have significant fiscal or other undefined consequences.

Second, with regard to Landsat data, we recommend that the legislative provisions which would establish specific pricing and dissemination policies for unenhanced Landsat data be deleted. During the development of the Administration's Landsat Policy, we examined a number of data pricing and dissemination alternatives, and we found that the issues affecting the different user communities are very complex. In assessing these various data policy alternatives, our goals were: to seek to maintain data continuity for global change research, national security and other purposes; to assure that Federal data needs are satisfied; to foster U.S. leadership in remote sensing; and to encourage future commercial opportunities related to land remote sensing.

To assure that Federal government needs for the data are met, we concluded that price should not be a barrier to the use of Landsat 7 data for global change and environmental research, national security, and other Federal government purposes. Therefore, as a first principle, we are planning to provide data for global change research at the marginal cost of fulfilling a specific user request, consistent with the Administration's policy statements on Data Management for Global Change Research.

We believe this is necessary to achieve the Federal purposes for which the Landsat program is being conducted. For Landsats 1-6, NASA will seek to negotiate an agreement such that data from Landsats 1-6 are made available in a manner similar to the arrangements for data access and acquisition for Landsat 7.

For other users of Landsat data, we believe unenhanced Landsat data should be treated just like any other Federally produced data. Thus, we do not believe that Landsat data should be treated as a special case in legislation. Instead, we would like to see it dealt with through a broader regulatory process to be governed by the Office of Management and Budget's (OMB) Circular No. A-130 on Management of Federal Information Resources. This circular applies to all types of Federally produced data. On April 29, 1992, OMB published for comment a proposed revision to Circular No. A-130 in the Federal Register. While the public review process will require several months, the general principles are clear. The proposed A-130 would establish a standard that Federal agencies set user charges for Federal information products at a level sufficient to recover only the cost of dissemination. The Administration's policy statement on Data Management for Global Change Research was developed to be consistent with this concept, and will be reviewed to ensure that it reflects recommendations from the Circular No. A-130 public comment and review process. am providing a copy of the Federal Register notice for the record. We believe that this proposed policy is consistent with the intent of the proposed legislation and will have the effect of expanding the use of Landsat-type data without making unenhanced Landsat data a unique or special case.

Now I would like to turn to the Landsat Management Plan, and to discuss the status of our efforts to date. The Management Plan outlines the goals of the program, and the respective roles and responsibilities of NASA and DoD. The Plan establishes the first principles that will guide the program through the operational lifetime of Landsat 7, with potential follow-on programs to be covered by separate agreements in the future. DoD, representing the national security community, and

NASA, representing the U.S. Global Change Research Program and the civil/private Landsat use community in general, will divide the management responsibilities and costs for the program with approximate equality. NASA and DoD have almost completed requirements definition for Landsat 7. DoD will soon release the Request for Proposals for development of the Landsat 7 spacecraft. As part of this process, the NASA Office of Space Science and Applications is working to develop program and project plans to implement the NASA portion of the program.

Although NASA and DoD have agreed upon defined roles for each agency, we will be closely coordinating our activities. There will be NASA participation in the DoD project office, and vice-versa, to assure that the technical details for each part of the program are understood by all. Also, NASA and DoD will form a jointly chaired Landsat Coordinating Group which will coordinate the top-level program documentation such as program plans, budgets and policies, as well as handling inter-agency matters and resolving issues as they arise.

The Landsat program will be structured to meet a set of basic goals. First, it will be designed to maintain data continuity, both in terms of maintaining a source of data by seeking to launch Landsat 7 five years after the launch of Landsat 6, and by ensuring that the data from Landsat 7 is consistent with data from Landsats 4, 5, and 6. The system will continue to provide data which are sufficiently consistent in terms of acquisition geometry, calibration, coverage, and spectral characteristics with previous Landsat data to allow comparisons for global and regional change detection and characterization. Second, the system will be operated in such a way as to make data available to all U.S. civil, national security, and private sector users. Third, we will seek to expand use of Landsat data for global change research, national security and other purposes.

At a minimum, Landsat 7 will be functionally equivalent to Landsat 6, except that it will have a Tracking and Data Relay Satellite (TDRSS) communications capability. Additional improvements will be sought only if they do not increase risk to data continuity, and are attainable within agreed-to funding. DoD will have the lead responsibility for the acquisition and launch of the Landsat 7 satellite. NASA will provide appropriate participation in the responsible DoD project office as required. Beyond developing Landsat 7, DoD will have the lead, with assistance from NASA, the Department of Energy and other agencies, in developing a technology plan which evaluates the need and alternative means for implementing follow-on satellite systems and improvements beyond Landsat 7, including commercial alternatives.

NASA will have the lead responsibility for the development and operation of the Landsat ground system, including data processing, archiving (in cooperation with the Department of the Interior), distribution, user support and mission operations management. NASA will administer the program in coordination with the Mission to Planet Earth Program. DoD will provide appropriate participation in the responsible NASA project office as required. The ground system will be developed so as not to preclude private sector participation. NASA will be the lead agency responsible for Landsat operations and data management. NASA and DoD, through the NASA project office, will develop a collection scheduling system that assures access to data by all users in a timely manner. Users will be allowed to provide input into collection scheduling and access to data. Our baseline mode will be to acquire as much data as possible over cloud-free land areas for global change research. In all cases, Landsat data will continue to be unclassified.

NASA and DoD are each funding their respective responsibilities in the program. Thus, DoD is funding the procurement and launch of the Landsat 7 satellite, and NASA will fund satellite operations, and data processing, archiving, and distribution (including any ground hardware and facilities that are required). The two agencies' total funding responsibility will be approximately equal as spread across the development and operational life of Landsat 7. Any improvements over a Landsat 6 functional equivalent capability for Landsat 7 will be funded by the sponsoring agency, if the required funding exceeds the baseline funding agreed to by the two agencies. If it is agreed that improvements benefit the interests of both agencies, they would be funded based upon a mutually acceptable sharing arrangement approved by the Deputy Secretary of Defense and the NASA Administrator.

In the area of international cooperation, NASA will have the lead responsibility, with DoD support, for evaluating opportunities for international cooperation and utilization of Landsat. NASA will also have the lead responsibility for arranging for the reception of Landsat data by foreign ground stations.

In conclusion, I would like to reiterate NASA's commitment to the Landsat program. NASA and DoD have developed a strong partnership, we have established our goals, and we are moving ahead to meet the Administration's goal of continuity of Landsat-type data. I believe that Landsat is an important contributor to global change research and that it makes a strong contribution to many of our national

goals. Mr. Faga and I look forward to working together with other Federal agencies and the Congress to implement this program. Thank you.

Senator GORE. Thank you very much for an excellent statement, Dr. Fisk and for setting a good precedent, staying right within the time limit.

Martin Faga, Assistant Secretary for Space with the Department of the Air Force is our next witness. Welcome. Please proceed, Marty.

STATEMENT OF MARTIN C. FAGA, ASSISTANT SECRETARY FOR SPACE, DEPARTMENT OF THE AIR FORCE, THE PENTAGON

Mr. FAGA. Thank you very much, Senator. It is a pleasure to be here, to be before this committee and in support of this program.

I would like to start off, give a little explanation of why DOD is interested in the program and also to assure you at the outset that despite our participation, it does not mean that the program will become classified. We have no interest in classifying the program, and in fact, the many users in DOD, in the various using commands that apply the data today want continued unclassified data and that is what we intend to provide them in this program.

We have wide ranging needs for Landsat data and in fact, DOD is currently the largest single consumer of Landsat product and it is widely used, as you may know, our could easily imagine in hydrography, counternarcotics, support for military operations, mapping, arms control, treaty monitoring, and a wide range of other purposes.

As Len Fisk has indicated, DOD and NASA have developed an integrated management plan where we will procure the satellite and provide the overall systems engineering function and NASA will be responsible for the ground systems and all data dissemination activities. We in DOD will also develop, in company with NASA and with the Department of Energy, a program for advanced technology supporting future Landsat activities.

I will not add to what Len has already said about S. 2297 except to say that we support its support for Landsat activities and hold the same reservations that he has expressed.

With respect to the program itself, we expect that Landsat 6 will be launched in January 1993 and that by late 1997 this Landsat 7 vehicle will be needed. And we have an acquisition program plan in DOD that will provide for meeting that date.

The Landsat 7 will be functionally equivalent to vehicle 6 and that means that the design may not be the same, but that the same functions will be provided, the same bands of information will be provided and it will be at least 30 meters with a 15-meter panchromatic band which will start to be a new capability on Landsat 6.

It will also add the capability to use the NASA TDRSS relay system so that data can be relayed directly to the United States from wherever the satellite may be operating. Additional capabilities will be considered in our plan, and our request for proposal will provide for this, but only if we can meet the acquisition time lines that we need and stay within the budget that we have.

DOD and NASA are each funding their portion of the program. It is roughly equivalent amounts of money over the next 10 years,

although the acquisition of the satellite puts more DOD money in earlier years and NASA money tends to come in greater amounts in later years.

And we have a coordinating group among our two agencies and others that are involved to work out all of the many details that are involved. We and NASA also have a formal policy connecting up mechanism that will deal with our top level issues involving funding and requirements and those kinds of matters.

All of this is working very well in my view, and I would like to conclude by stating, as Len has, that we in DOD strongly support the program and see it as a fundamental step toward continued U.S. leadership in this arena.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Faga follows:]

PREPARED STATEMENT OF MARTIN C. FAGA

I am pleased to have this opportunity to discuss the role of the Department of Defense (DoD) in the continuation of the Landsat Program. The National Aeronautics and Space Administration (NASA) and DoD agree that the Landsat program provides a unique capability that benefits a wide community of users; including the global change research community, other U.S. Government users, and the private sector. For these reasons our two Agencies are committed to the goals of Landsat data continuity, and continued data availability for all users, including those in the private sector. In doing so, we will seek ways to encourage remote sensing commercialization and economic growth over the long term.

Before discussing Landsat program specifics, I'd like to address an issue that I know is of concern, that is, the perception that DoD involvement may somehow result in program security classification, thus shutting the door to many current Landsat users. I assure you, no Landsat system will ever be classified.

NASA and DoD will execute Landsat 7 as an unclassified program. In fact, this position is strongly supported by DoD operational users since it will give them ready, uncomplicated access to data. And while we do want to improve the system for National security users, the NASA/DoD goal is to preserve continuity of data and to provide access to same users that receive service today. In certain situations it may be necessary in the future—as it has occasionally been in the past—to temporarily suspend data availability to specific users because of national security concerns. NASA and DoD propose to develop procedures to minimize the impact of restrictions to Landsat system users in such circumstances.

In addition, DoD is actively involved in the Landsat program because we have a need for continued Landsat data. In support of National Space Council Landsat activities of the past year, a survey of the DoD (Joint Staff, DIA, DMA, U & S Commands, Services, and Technology centers) found that unclassified Landsat data provides substantial value in addressing a variety of national security needs. An interesting item is that the DoD is currently the largest consumer of Landsat data. In fact, every Unified and Specified Command has identified mission essential information requirements that can be satisfied by multispectral data. Typical Defense uses for this data include: targeting support, counternarcotics applications, hydrography, intelligence support for current operations, operations planning, mapping, charting, and geodesy, characterization of science/technology and military/industrial capabilities, and arms control and treaty monitoring.

These findings convinced senior DoD officials of the value of Landsat data to national security information needs and have further strengthened my personal commitment to the Landsat program. I want Landsat to succeed and am actively engaged in the process of making that happen.

NASA and DoD have developed an integrated management plan based on the guidance set forth in the President's National Space Policy Directive 5 on Landsat Remote Sensing Strategy. In general, DoD has the lead responsibility for the acquisition and launch of Landsat 7. NASA has the lead responsibility for the development and operation of the Landsat 7 ground system. In addition, the DoD Landsat Program Office will furnish general systems-level engineering and integration services in support of both the NASA and DoD Project Managers to maintain end-to-end fidelity of the Landsat system. Finally, DoD will have lead responsibility, with support from NASA, the Department of Energy, and other federal agencies, to prepare a coordinated technology plan for future Landsat-type U.S. Earth remote sens-

ing system. I will administer the DoD portion of the program as the Director, Defense Support Project Office, with resources provided through the Defense Reconnaissance Support Program. The National Space Council concurred in the NASA/DoD management plan on April 28th, and provided us with several useful member agency suggestions that we will apply in executing the program.

Before addressing the DoD plans for Landsat 7, I would like to briefly comment on S. 2297. We view the bill, along with substitute bill H.R. 3614, as a positive step forward for all remote sensing interests. There are however, some changes we would like to see in the proposed bill. The current bill calls for unenhanced data to be provided to users at no more than marginal costs. We prefer that pricing policy not be legislated, but rather be subjected to the normal regulatory process in determining the appropriate structure. My colleague Dr. Len Fisk will address this issue in more detail. Second, the President has assigned responsibility for Landsat 6 to the Secretary of Commerce through its launch, currently scheduled in January 1993. Landsat 6 operations are closely tied to Landsat data accessibility under the Government's contract with EOSAT, and we expect that NASA will have a programmatic interest in both making Landsat 6 data more readily accessible and in Landsat 6 operations. However, as yet the Administration has not determined which agency will have responsibility over Landsat 6 after launch. Finally, due to the responsibilities assigned to the Secretary of Commerce by the Land Remote Sensing Commercialization Act of 1984, we are reviewing this law as well as all related statutes to determine if any changes may be needed to conduct the planned Landsat program prior to enactment of new legislation.

Landsat satellites 4 and 5 have been operating well beyond their expected life of 3 years, and their status for the immediate future is uncertain. Landsat 6, with a design life of 5 years, is currently scheduled to launch in early 1993. Therefore, to allow for data continuity Landsat 7 should be available for launch in 1997. To support this goal, we have defined an aggressive acquisition strategy which includes a competitive procurement consistent with current and pending legislation. We have released a draft Request For Proposal (RFP) and are in the review cycle.

In FY 1992 Congress, through the Defense Appropriations Conference, appropriated \$10M for DoD Landsat activities and appropriated an additional \$20M subject to certifications to be made to the Congressional Appropriations Committees. We are actively pursuing the completion of these certifications, our acquisition strategy plans for the availability of funds early this summer. The aggressive acquisition strategy goal is for contract award as soon as possible, hopefully this summer, to permit us to meet our current schedule for launch of Landsat 7.

As part of our competitive acquisition, we intend to develop a Landsat 7 satellite which is, as a minimum, functionally equivalent in performance to the Landsat 6 satellite. One significant improvement will be the addition of a Tracking and Data Relay Satellite (TDRS) communications subsystem. This will give us greater communication capability and flexibility, with the added benefit and capability of easing integration of Landsat operations into NASA's EOS (Earth Observing System) operational architecture. Specifically, the Landsat 7 satellite will continue to provide data sufficiently consistent with previous Landsat data to allow comparison for global and regional change detection and characterization. However, improvements will be sought if they do not increase risk to data continuity, and are attainable within agreed-to funding profiles. Potential improvements could include features such as improved resolution, improved calibration, stereoscopic viewing, improved spectral characteristics, and other capabilities designed to increase the scientific, military, and commercial utility of the system.

As part of our approved integrated management approach, NASA and DoD will each fund that portion of the program for which it is responsible. A cost baseline has been developed, under a general guideline that each agency's total funding responsibility be approximately equal as spread across the development and operational life of Landsat 7. Any substantial improvements for Landsat 7 over a Landsat 6 functional equivalent capability would be funded by the sponsoring agency, if the required funding exceeds the baseline funds.

Although NASA and DoD have defined management responsibilities for the Landsat 7 program as part of our agreed to management plan, continuous coordination in all aspects of the program will ensure that the stated goals are achieved and the full user community is supported. NASA and DoD are developing an organizational structure that guarantees integration and fosters cooperation between the two organizations. For example, each organization will have individuals residing in the project office of their counterpart, and in a jointly staffed coordination facility in the Washington D.C. area.

On a more formal level, a jointly chaired Landsat Coordinating Group will be formed which will oversee interactions on top-level program plans, budget execution

and policies; handle interagency matters related to the program; staff any issues requiring adjudication at senior departmental levels; and coordinate any reports to Congress.

The Assistant Secretary of Defense for Command, Control, Communications and Intelligence (ASD/C3I)—Duane Andrews—will be the senior official responsible for DoD program oversight, policy, and issue resolution. As Assistant Secretary of the Air Force for Space and Director of the Defense Support Project Office, I will provide senior management direction and guidance for the Space segment of Landsat 7. Major General Nathan Lindsay, Director of the Office of the Secretary of the Air Force/Special Projects, will execute the Space segment acquisition program.

In closing, once again let me state that DoD is firmly committed to the continuation of the Landsat program into the next century. We have developed an excellent and affordable arrangement for Landsat with our partners in NASA and have established a very ambitious acquisition schedule to meet the data continuity goals established by the Administration. Our NASA/DoD team is moving forward with speed, enthusiasm, and a highly cooperative spirit. We look forward to continuing our work with you to meet the diverse needs of the broad user community. This program is a fundamental step towards continued U.S. leadership in space remote sensing—a goal we all share.

Thank you.

Senator GORE. Thank you very much, Mr. Secretary.

Dr. Dallas Peck is Director of the U.S. Geological Survey with the Department of the Interior. Welcome back, Dr. Peck. Please proceed.

STATEMENT OF DALLAS PECK, DIRECTOR, U.S. GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR; ACCOMPANIED BY, AL WATKINS, CHIEF, NATIONAL MAPPING DIVISION

Dr. PECK. Thank you, Mr. Chairman. It is a pleasure to testify before you Senator Pressler.

I am accompanied today by Mr. Al Watkins who headed our EROS data center in Sioux Falls, SD, for nearly 20 years and has recently joined us at headquarters as Chief of our National Mapping Division. Al is over here.

I apologize for the glasses, but I had cataract surgery a week ago and my eyes are rather sensitive to the glare.

Thank you for the opportunity to express the views of the Department of the Interior relative to the proposed Land Remote Sensing Policy Act of 1992. We support S. 2297 as implementing the administration's policy on continuity of data from the Landsat system to support national defense, global change, and other civilian requirements.

We have been involved in land remote sensing since well before the launch of Landsat 1 in 1972. Under Director William T. Pecora, we played a major role in defining the technical specifications for Landsat 1 and helped to develop an active program of remote-sensing applications and research throughout the Federal Government.

Through our EROS data center in South Dakota, we worked with NASA until 1983 to distribute Landsat data to all users. Since 1983 we have cooperated with the NOAA and EOSAT to assist in product generation and data distribution and to maintain the Landsat archive. That archive currently contains almost 1 million scenes of Landsat data.

Over the life of the Landsat program we have made many contributions to improve data processing, image enhancement, and distribution system capabilities. We are also a user of Landsat data for scientific and research purposes. We were an active participant

in support of Desert Shield and Desert Storm, producing unique and special purpose image products from Landsat data.

We are also participating in the development of NASA's Earth Observing System Data and Information System, EOSDIS. The USGS EROS data center will serve as the processing, distribution, and archive facility for providing land-related data and information to the global change research community.

S. 2297 provides for: one, continuation of the Landsat program to meet the needs of national defense, global change and other civilian uses; two, Government funding and management to assure that these needs are met; three, availability of low-cost data with adequate coverage to support national security, global change, and research needs; four, provision of data to the archive; and five, appropriate commercial involvement in partnerships.

Specifically, S. 2297 provides for joint funding and management of the Landsat program by NASA and DOD. This approach combines the management and technical competence of both agencies to ensure the comprehensive long-term acquisition of Landsat data. We have worked closely with both agencies in the past and are confident that we will continue to have an effective working relationship on future Landsat efforts.

With respect to data availability, it is especially important that Landsat data be routinely acquired around the world to provide the necessary repetitive coverage of the Earth's land areas. By the time of the launch of the first EOS platform at the end of this decade, the Landsat program will have collected data that document land surface conditions for a period of over 25 years.

S. 2297 requires data to be distributed at the marginal cost of filling a specific user request. The issue of data pricing is complex, and we believe this policy should be consistent with policies applied to other federally provided data, as stated by Senator Pressler and by my colleague, Len Fisk.

Accordingly, we prefer that the legislation not provide specific data pricing policy. The data approach outlined by Dr. Fisk reflects our preferred mechanism for dealing with this issue. This will help those who have been effectively excluded from using Landsat data because of rising data costs during the past few years, and should encourage others to use the data for important applications to Earth science research, environmental monitoring, and global change studies.

With the Government's promise of program continuity, wide access to low-cost data should allow many organizations to make a substantial commitment to use Landsat data.

The legislation requires that the Department of the Interior shall continue the maintenance of the Landsat data archive and ensure that all new Landsat data are archived for future use. We are very comfortable with such a role.

We favor appropriate involvement of the commercial sector to increase the usefulness of the data. By offering minimally produced, unenhanced data to the public, value-added services can be provided by the commercial sector to satisfy the information needs of their customers. This may lead to significantly enhanced commercial market development and demand for Landsat-type data.

In closing, Mr. Chairman, I would like to thank you for the opportunity to make these comments about the future of the Landsat program on behalf of the Department of the Interior. We will continue to work with Congress, NASA, DOD, and the private sector to see that the Landsat program is continued in a way that optimizes benefits to the Nation and provides a framework for long-term program continuity.

Thank you.

Senator GORE. Thank you very much, Dr. Peck.

Our final witness on this panel is Mr. James Frelk, Director of the Office of Space Commerce with the Department of Commerce. Welcome and please proceed.

STATEMENT OF JAMES J. FRELK, DIRECTOR, OFFICE OF SPACE COMMERCE, DEPARTMENT OF COMMERCE

Mr. FRELK. Thank you, Mr. Chairman. It is my first time before you and I welcome the opportunity to address you on this issue and to convey the Department of Commerce's views on the future of Landsat remote sensing.

As you know, as part of the Office of the Deputy Secretary of Commerce, the Office of Space Commerce has been responsible for representing the Department at the National Space Council's deliberations on the future of Landsat.

These deliberations have resulted in the recent Landsat policy which reaffirms the administration's support for and the importance of Landsat-type multispectral imaging and provides a plan for maintaining continuity of data from Landsat coverage beyond 1998.

My colleagues here have covered a number of issues that I will not go over, other than to say that the Department of Commerce is committed to the completion of Landsat 6 and getting it up there and operating, and we will be working with the other Departments in this transitional period to make it as smooth as possible.

One of the goals of the administration's Landsat policy remains the promotion of private sector commercial opportunities in Landsat-type remote sensing. Existing U.S. Government activities can be improved to further commercial interests, while ensuring that essential Government needs are met.

We are encouraging the private sector in three ways: by seeking to remove unnecessary legal and regulatory barriers; by developing new technologies to reduce the cost and increase the performance of future systems; and by developing a balanced pricing and dissemination policy for public remote sensing data in the future.

First, the new Landsat policy calls for limiting U.S. Government regulations affecting private sector remote sensing activity to only those required in the interest of national security, foreign policy, and public safety. In the past, when a U.S. oil company and a major news organization asked the Commerce Department about getting licenses for operating private remote sensing satellites, they were told that current law and regulations would require them to sell their data to anyone who asked at the same price, even to competitors.

This was certainly a deterrent to those potential private investments and an example of the sort of restriction which needs to be

changed. Recently, major aerospace companies like Lockheed and Orbital Sciences Corp. and smaller firms like World View Imaging Corp. and Earth Vision Systems and the prominent International Small Satellite Organization, wrote to the Department of Commerce requesting that restrictive pricing practices for private remote sensing firms be eliminated.

We believe that the law and implementing regulations should be revised to establish a distinction between publicly and privately financed satellite systems that allows private systems to operate in accordance with market conditions. Hopefully, this change will encourage firms to offer new sources of data which can contribute to economic growth as well as greater understanding of the Earth's environment.

Second, the administration is encouraging the development of new satellite technology for remote sensing which can serve further commercial as well as Government needs. Satellite technologies developed within the Department of Energy's laboratories hold the promise of reducing remote sensing costs and enhancing capabilities for future Landsat-type systems.

Their development by DOE has been made possible through a \$2 billion investment by the Government over the last 3 years in defense research, associated with creating smaller satellite components. Many of the existing and space-tested components developed by the Energy Department are much smaller than current Landsat type of components.

The President's Landsat policy directs the Department of Energy, with DOD and NASA and other appropriate agencies to work together to prepare a coordinated technology plan with the goal of improving the performance and reducing the cost for Landsat-type remote sensing systems.

Third, as mentioned by my colleagues here, we are developing a balanced and consistent pricing and dissemination policy for remote sensing data from public systems such as Landsat 7. During the development of the Landsat policy we found that there are a number of data pricing and dissemination alternatives, that the issues affecting the different user communities are very complex, and that there is value in maintaining a flexibility to adjust our policies as circumstances change and attractive alternatives present themselves in the future.

This is particularly true in the area of data policy. We believe that the policy for Landsat data should be consistent with policies applied to other forms of public data. The approach outlined by my NASA colleague reflects an approach, and an appropriate process for distributing data from civil government satellites.

In the end, I think that the administration's policy and the President's policy on this is a balanced one. We are definitely committed to maintaining the continuity of Landsat-type data for use such as national security and global climate change research.

Mr. Chairman, we share your desire to see a program developed which furthers U.S. leadership in remote sensing. We look forward to working with you and this committee in fostering commercial opportunities in remote sensing and providing U.S. Landsat-type systems, both public and private with a bright future.

Thank you for your kind attention.

[The prepared statement of Mr. Frelk follows:]

PREPARED STATEMENT OF JAMES J. FRELK

Thank you for the opportunity to share with this committee the Department of Commerce's views on the future of Landsat remote sensing. As you know, as part of the Office of the Deputy Secretary of Commerce, the Office of Space Commerce has been responsible for representing the Department at National Space Council deliberations on the future of Landsat. These deliberations have resulted in the recent Landsat policy which reaffirms the Administration's support for and importance of Landsat-type multispectral imaging and provides a plan for maintaining continuity of data from Landsat coverage beyond 1998.

Multispectral images from Landsat satellites support U.S. national security needs, governmental research requirements (including global climate change), and provide commercial opportunities to the private sector. Consequently, the President's new Landsat Policy Directive assigns the Department of Defense (DOD) and NASA with the responsibility of funding and managing the next Landsat satellite (Landsat 7). The Directive instructs NASA and DOD to develop and operate a Landsat 7 satellite of at least equivalent performance to Landsat 6.

In coordination with other agencies, including Commerce, DOD and NASA have prepared a plan detailing the funding and management responsibilities, data handling, and commercial considerations associated with the Landsat 7 program. This plan is complete and has been fully reviewed by the National Space Council. Prior to the deployment of Landsat 7, the Department of Commerce, through the National Oceanic and Atmospheric Administration (NOAA) is committed to the completion and launch of Landsat 6 and, in coordination with the Office of Management and Budget, will arrange for continued operation of Landsats 4 and 5 until Landsat 6 is operational.

One of the goals of the Administration's Landsat policy remains the promotion of private sector commercial opportunities in Landsat-type remote sensing. Existing U.S. government activities can be improved to further commercial interests while insuring that essential Government needs are met. We are encouraging the private sector in three ways—by seeking to remove unnecessary legal and regulatory barriers, by fostering the development of new technologies to reduce the cost and increase the performance of future systems, and by developing a balanced pricing and dissemination policy for public remote sensing data.

First, the new Landsat policy calls for limiting U.S. government regulations affecting private sector remote sensing activities to only those required in the interest of national security, foreign policy, and public safety. In the past, when a U.S. oil company and a major news organization asked DOC about getting licenses for operating private remote sensing satellites, they were told that current law and regulations would require them to sell their data to anyone who asked at the same price—even their competitors. This was certainly a deterrent to those potential private investments and is an example of the sort of restriction which needs to be changed.

Recently, major aerospace companies like Lockheed and Orbital Sciences Corporation; smaller firms like World View Imaging Corporation and Earth Vision Systems, Inc.; and the prominent International Small Satellite Organization have written to the Department of Commerce requesting that restrictive pricing practices for private remote sensing firms be eliminated. We believe that the law and implementing regulations should be revised to establish a distinction between publicly and privately financed satellite systems that allows private systems to operate in accordance with market conditions. Hopefully, this change will encourage firms to offer new sources of data which can contribute to economic growth as well as a greater understanding of the Earth's environment.

Second, the Administration is encouraging the development new satellite remote sensing technologies which can serve future commercial as well as government needs. Satellite technologies developed within DOE's National Laboratories hold the promise of reducing remote sensing costs and enhancing capabilities for future Landsat-type systems. Their development by DOE has been made possible through a \$2 billion government investment over the last three years in defense research associated with creating smaller satellite components. Many of the existing and space tested components developed by the DOE are much smaller than current Landsat satellite components.

Due to these and other developments since the National Space Council's 1989 review, the President's Landsat Policy directs DOE, DOD, NASA and other appropriate agencies, to work together to prepare a coordinated technology plan with the goal of improving the performance and reducing the cost of future Landsat-type remote sensing systems. Mr. Chairman, plans to improve our remote sensing capabili-

ties recognize in principle the importance that new technologies will play in the future, and helps further U.S. leadership in Landsat-type remote sensing.

Third, we are developing a balanced and consistent pricing and dissemination policy for remote sensing data from public systems such as Landsat 7. During the development of the Landsat Policy we found that there are a number of data pricing and dissemination alternatives; that the issues affecting the different user communities are very complex; and, that there is value in maintaining a flexibility to adjust our policies as circumstances change and attractive alternatives present themselves in the future. This is particularly true in the area of data policy. We believe that the policy for Landsat data should be consistent with policies applied to other forms of public data. In addition, it would be premature to set in legislation data pricing practices for a satellite that may not fly till the end of this decade. The approach outlined by my NASA colleague reflects an appropriate process for distributing data from civil government satellites.

The Administration is committed to maintaining the continuity of Landsat-type data for uses such as national security and global climate change research. The President's new Landsat Policy strikes a balance in assuring a continued stream of remote sensing data to meet vital government requirements, while at the same time strengthening U.S. remote sensing capabilities by eliminating legal and regulatory barriers affecting the private sector and fostering the development and application of new satellite technologies. Mr. Chairman, we share your desire to see a program developed which furthers U.S. leadership in remote sensing. We look forward to working with you and this committee in fostering commercial opportunities in remote sensing and providing U.S. Landsat-type systems, both public and private, with a bright future.

Thank you for your kind attention and the opportunity to speak to you today. I would be happy to answer any questions that may have.

Senator GORE. Thank you very much.

I will open with a few questions and then recognize Senator Pressler for his questions.

Dr. Fisk, you and other witnesses on this panel have talked about the very complex situation that exists with respect to the Landsat data policy. I do not want to disagree with your assessment, but two general policy proposals for addressing the Landsat data situation are now pending in the Congress.

One of them is the bill introduced by Senator Pressler which proposes a single tier pricing structure and the House committee has already approved a bill that would create a two-tiered pricing policy.

Is it not possible for NASA to support one approach or the other? Or are you advocating that we continue the current situation?

Dr. FISK. No, Senator, it is possible. NASA and the administration supports a single tier policy and that is reflected in OMB Circular A-130 which is basically intended to provide the data at the marginal cost of reproduction.

Now the only comment I would make on that is the one I made in my testimony, that we really think there is an opportunity here to do this essentially by regulation as opposed to by legislation and the opportunity—I think what the legislation should be very clear on are what the broad principles are that should be followed in the data dissemination policy.

But I would, I think the administration would prefer if we had the flexibility to implement that, as you can see by the draft copy of OMB A-130, the intention on how to implement that is stated and I think it is very consistent with S. 2297.

Senator GORE. Now the comment period is not up until August on that Circular A-130; correct?

Dr. FISK. I think that is correct; yes.

Senator GORE. And you are not required to actually do anything under—I mean, the administration does not actually have to do anything under A-130. If it chooses to do nothing, that would be one of the options that could be chosen; correct?

Dr. FISK. It is possible to modify A-130 from the draft copy, that is certainly true. But the position is really quite clear on this, that on the, as regards to Landsat 7 data, the administration's preference is to be able to deal with this in a very simple system that says the data is available to all users for the marginal cost of reproduction.

Now we believe—and this of course is unenhanced Landsat data, the intention is it is unenhanced and that there is an opportunity for value-added industries to take that and turn it into data products which we think will make a very interesting and lively commercial market.

But I think that is a—from the people who will administer this, let me equate it also from the NASA point of view, the people who would administer this, this is a much more straightforward way to do it than would be involved in trying to separate out who are research users and who are not.

Senator GORE. Well, of course, one of the questions here is whether or not it makes more sense to just settle the data policy issues once and for all with a change in the statute or trust the resolution of this unsatisfactory situation to a process that does not really require a change.

If Landsat legislation contained no specific policy prescriptions on data pricing and dissemination as you and your colleagues advocate, what would be the prevailing statute? Would not the 1984 Landsat act still be the prevailing statute?

Dr. FISK. I would not be silent on the issue of the data policy, but I think you will have to deal with the repeal of existing portions of the current existing legislation and I would encourage you to state the principles. The thing I think that—

Senator GORE. Now, wait a minute. You do recommend a legislative change to repeal portions.

Dr. FISK. Absolutely.

Senator GORE. Now, if all data is provided at marginal cost of reproduction, what would be the impact on EOSAT and the existing contract, which gives that company exclusive rights to market data from Landsat's 4, 5, and 6?

Dr. FISK. Well, I think again the data policy that is easy to write is the one that applies to Landsat 7. That is the Federal Government's—

Senator GORE. You are advocating repeal of the legislation as it applies to—portions of the legislation as it applies to 4, 5, and 6 also; correct?

Dr. FISK. What I am advocating here is that we have—well, what we will have to do with Landsat 4 through 6 is deal with it by negotiation.

Senator GORE. Wait a minute. Let me see if I can get an answer to the question. Now, I want to know what you are advocating. You said you were advocating a repeal of portions of the legislation, portions of the 1984 statute, but now you seem to be implying that you are unclear in your own mind as to whether that applies only pro-

spectively to Landsat 7 or whether it applies also to the way we treat data from 4, 5, and 6. Can you clarify that?

Dr. FISK. Let me try and be as explicit as I can here, and since I do not have copies of legislation in front of me, let me tell you what the principle is that I would like to see us achieve here, and then the details of the legislation.

Senator GORE. But in the process, please try and answer that specific question.

Dr. FISK. I will try and answer that specific question. Landsat 7 is straightforward. We want to be able to build Landsat 7 and provide the data at the marginal cost of reproduction to all users, and a Federal Government A-130 policy will apply. In the case of Landsat's 4 through 6, the Government's intent is to be able to have that data available to researchers—Federal Government researchers as much as we can make available.

Now, it is my belief, and this may be a matter of law, that the EOSAT Corp. by contract is essentially the proprietor of the Landsat 6 data. I would question, I think, whether or not you could retroactively change that contractual arrangement, and so what we would recommend is that there are negotiations that take place between the Federal Government and the EOSAT Corp. with, at the very least, the intent being that the Federal Government users, which are the research users and also the national security users, get that data at the least possible cost close to marginal cost of reproduction.

But I believe the EOSAT Corp. by contract has the right to sell the Landsat 7 data—excuse me, the Landsat 6 data—for commercial use at the price that they would set by their contract, and I would question whether or not we had even the legal right to retroactively do that, but I do want to—our intent, I mean, if you say what is the basic principle here, is we want to get access to Landsat 4 through 6 data for the least possible cost to the Federal Government users.

Senator GORE. Well, what about non-Federal Government researchers? Are you going to leave them in the soup?

Dr. FISK. I am going to try not to.

Senator GORE. We have not heard anything about them, though, where 4, 5, and 6 are concerned. Are they going to still have to pay \$4,000 a scene and therefore not have any practical access to the data?

Dr. FISK. Well, again, by contract the data is the property—Landsat 6 data is the property of EOSAT and we will negotiate to get the data that we can for the Federal users.

Senator GORE. By purchasing it?

Dr. FISK. At what will hopefully be the minimum cost; yes.

Senator GORE. This was really a stupid idea back in 1984, was it not? [Laughter.]

Dr. FISK. Yes, Senator. [Laughter.]

I was not here. [Laughter.]

Senator GORE. We want to make sure that is part of the record. [Laughter.]

I am going to skip over some of my questions until a second round because I want to get expeditiously to Senator Pressler, but let me ask you, Mr. Faga, you mentioned in your statement that

the draft request for proposals for the Landsat 7 spacecraft contract has been released. When do you expect the final RFP to be released?

Mr. FAGA. We expect it to be released this summer, but we do have some funding issues in 1992. We only had \$10 million. That is clearly provided in 1992, and we are fortunate to have that, because there was no administration request for 1992 money. It was provided by the Congress.

There is also \$20 million that has been earmarked by the Congress for this purpose but there are certain certifications and information requirements that have to be met and they are in the process of being met now, so we will have that material on the Hill shortly and then hope to get the release of funds or an agreement to release funds and go forward with the final RFP in the summer.

Senator GORE. Give me an estimate of when that implies the contract is likely to be awarded for the spacecraft development. Do you have a guess on that?

Mr. FAGA. Early next calendar year.

Senator GORE. Early next calendar year.

Mr. FAGA. Right.

Senator GORE. There were several enhancements to the Landsat 6 spacecraft that you said would be sought, provided that they do not increase the risk to program cost and schedule. How will these enhancements, these technologies be funded, out of spacecraft development funds, or from funds dedicated to technology development, and do you consider them to be a priority for Landsat 7?

Mr. FAGA. Let me make my earlier statement more clear. There are improvements in Landsat 6 over earlier vehicles. All of those would remain as baselined. Further improvements for 7 beyond anything in 6 are things like stereo capability, higher resolution, panchromatic capabilities, say 5 or 10 meters instead of 15.

Those kinds of capabilities are being provided in the RFP as goals, things we are interested in. We would fund those if we were the interested party, DOD, which would likely be the case. If there was something in processing that was driven by NASA desire, they would fund that, or if someone else came to the table with a requirement that we had not previously met, then they would fund it.

Senator GORE. DOD is now the largest single consumer of Landsat data; correct?

Mr. FAGA. Yes.

Senator GORE. What price does DOD pay EOSAT for the Landsat data it acquires?

Mr. FAGA. We pay the standard commercial price of \$3,000 plus per image, and of course observe the requirement that we cannot reproduce it so that if one element of DOD buys it and another element needs it, it also has to buy it.

Senator GORE. What is the total in the current fiscal year paid by DOD to EOSAT for these images?

Mr. FAGA. I think it is \$6 million, but having said that number I am going to turn to my assistant and see if I am right. Yes, \$6 million approximately.

Senator GORE. You told us how you, Assistant Secretary Dwayne Andrews, and Maj. Gen. Nathan Lindsey will be responsible for

managing the Landsat 7 program within the Air Force. How does the Strategic Environmental Research and Development Program fit into the Landsat program within DOD, and is there any effort to integrate these two initiatives?

Mr. FAGA. They would set requirements for the data and in theory could provide a part of the funding from SERDP funds, but that is not the case. That is, none of the funds that are programmed in DOD for Landsat come from the SERDP.

Senator GORE. You can supplement that response for the record, if you wish, about the integration of the two programs. I would like to hear a little more about that for the record.

[The information referred to follows:]

The current Defense Support Project Office (DSPO) SERPD effort focus on use of existing classified and unclassified assets. The use of classified data with data from unclassified sensors, including Landsat data, is a key part of DSPO study activities. Although the current SERDP program does not address system modifications or design of future systems, future proposals will address how systems, like Landsat, could be supported by SERDP sponsored R&D activities.

Senator GORE. Dr. Peck, in your statement you said the Geological Survey favors involvement of the commercial sector to increase the usefulness of Landsat data. What does that mean in practical terms? Does that mean you would like to see a private contractor continue to have the exclusive marketing rights for the unenhanced Landsat data, or are you referring to the possibilities that might exist for an enhanced value-added industry if data were provided at the marginal cost of reproduction?

Dr. PECK. I think very much the latter, Senator—a competitive situation.

Senator GORE. All right. Now, your statement makes reference to the fact that "with the Government's promise of program continuity, wide access to low-cost data should allow many organizations to make a substantial commitment to use Landsat data."

That is a little confusing. How can continuity of Landsat data which I strongly support automatically translate into widespread access to low-cost data?

Dr. PECK. I think the point I was trying to make in the testimony, Senator, is that some doubts about the future continuity of the Landsat data have discouraged the investments for reliance on that data by a variety of commercial and noncommercial users.

Senator GORE. Now, if I were the Geological Survey and noticed that S. 2297 specifically gives the Geological Survey authority to maintain the Landsat 7 data base I would support this bill. Do you?

Dr. PECK. Yes, enthusiastically.

Senator GORE. There are some other questions I have there, but I am sure that Senator Pressler is going to get into the EROS Data Center issues and so I will refrain and be very interested in his exchanges.

Just one final couple of questions here, Mr. Frelk. In your testimony you referenced the fact that the Department of Commerce is in the process of examining any restrictions that exist on the sale and distribution of remote sensing data from privately financed satellite systems. What is the status of this effort?

First, let me ask you what the status is with respect to companies or organizations developing and launching their own privately financed remote sensing systems. Do you expect this to occur during this decade?

Mr. FRELK. I would point out that there were two requests, or at least inquiries about licenses for satellites.

Again, we are not talking about something that is identical to a Landsat satellite which provides a great deal of capability not only for the environmental community but for Government needs, but these would be more limited remote sensing activities. These would probably be somewhat different than current capability. We are not talking about as difficult a problem, first of all.

Again, I would point out that there were two initial inquiries, one from the media outlet and one from an oil company. I think that certainly within this decade that somebody could put up a remote sensing satellite for specific commercial purposes and pay for it themselves.

I would also note that Orbital Sciences Corp. has invested some money in SEASTAR in cooperation with NASA so that there may be additional cases in the next decade where private companies might be impeded from putting something up. In fact, companies have communicated that to us, and that is why we are in the process of reviewing existing legal and regulatory restrictions and pricing practices that would apply to private firms.

Senator GORE. And you stated that the law, in your opinion, should be revised to establish a distinction between publicly and privately financed satellite systems. Specifically, what legislative provisions need revision, and is the administration willing to propose legislation in this regard?

Mr. FRELK. We will be happy to provide to the committee specific line-in and line-outs in our proposal. It is the Commercialization Act of 1984 that mandated treating private remote sensing and public identically in pricing practices and dissemination.

Senator GORE. And you think that ought to be changed.

Mr. FRELK. I think that ought to be changed; yes.

Senator GORE. All right. Are there regulations now in place which act as barriers to entry to private systems?

Mr. FRELK. I think this one specifically dealing with pricing practices and dissemination does. I will give you an example. A company—a small company might want to go out and try to get financing for the capital cost of a satellite and as maybe somebody building a building would do, they might look for an anchor tenant to enter an exclusive arrangement with somebody in return for preferential treatment. They would get some cash.

Well, again, current law and regulations prohibit that from taking place, so that these firms who even want to go out and raise capital to build the satellites themselves are facing impediments as to what they can and cannot do as far as practices.

Senator GORE. All right. Now, one group interested in this matter, the Radio Television News Directors Association, argues in a statement submitted for the record that current law, and I quote from their statement, "does not adequately accommodate constitutional requirements with respect to the first and fourth amendments, and that the Commerce Department regulations do not im-

plement the act in a manner consistent with the Constitution." Can you comment on these concerns and the statement of this group and tell us what steps you have taken with respect to the regulations to which they make reference?

Mr. FRELK. I would prefer to get back to you in writing, if possible, on that.

Senator GORE. That will be fine.

Senator GORE. We will provide you with the statement they have supplied for the record for your response if you have not seen it.

Now finally, is it possible to eliminate these barriers to entry without affecting access by researchers to foreign satellite systems? In other words, how can we assure user access to a system like the Japanese Earth Resource Satellite to be launched next year if we change the nondiscriminatory access principle for private satellites.

Mr. FRELK. In the specifics of what we are talking about, the principle that a State could, for Government purposes, for non-commercial purposes, have access to images would still apply. It would simply be private sector selling to a private sector that would fall into that type of pricing practice and allowance for discrimination in access.

Senator GORE. I see. OK. Senator Pressler.

Senator PRESSLER. Thank you very much, Mr. Chairman.

But in any event, as I see the issue and I would like to ask the panel, anybody of the panel to respond to this, one of the groups that is endorsing this legislation is the National Association of State and University Land Grant Colleges. Another is the National Farmers' Union. Another is the National Congress of American Indians and then there are several wildlife groups and environmental groups.

But what we are really trying to do here, as I understand it, is to achieve a situation where if somebody wants one of these pictures, let us say that they are working at the University of Nevada, they could access a supercomputer, hopefully which is located at the EROS data center in Sioux Falls, SD.

They could access a supercomputer, an index and then they could obtain a picture that they could use and reproduce or research at a very reasonable price, and is that not what we are trying to achieve, regardless of what bill we are under. That is what I am trying to achieve. Is that a good objective?

Presently, we do not have the situation where some researcher of modest means at the University of Nevada or the National Association of Counties or the Farmers' Union or the National Parks and Conservation Association or the—I could go on and on and on, the Wildlife Management Institute, could find out what is available on a computerized index and could get the picture at a reasonable price and use it or reproduce it or whatever. Is that what we are trying to achieve? Is that a good policy goal?

Dr. PECK. If I might comment, Senator, not only are we trying to achieve that and that is a very good goal, but on top of everything else, we want the availability, we want a system so that that data is available, so that it is gathered.

We were all worried that after Landsat 6 there might be no Landsat data available, so this is, I think, one of the very positive changes that has come about in the last year or so and incor-

porated in this bill and in elements of the bill over in the House. So, I think it is a good development; yes.

Dr. FISK. Senator, let me also comment, it is—just amplify on Dallas's point, in some cases there are two demands on this data. There is the local use which are some of the groups that you cited, people that are interested in their own particular area, but from the perspective of the global change researcher, the thing that is very appealing here is the opportunity to have global coverage of the Earth with a satellite that is capable of Landsat which has such a long, historical data base to use.

So, I think what you are going to find as we move into the Landsat era, Landsat 7 era, that we are vastly increasing the amount of data that will be processed through the Landsat satellites because we are equipping this with a TDRSS antenna for example, so you can get essentially continuous coverage.

We are sizing the data system to be able to process many more scenes than were processed by the commercial contractor for Landsat because the global change user is interested in much broader areas, and so this system is essentially moving into the global change world from what was a more regional world of its earlier uses.

Senator PRESSLER. I would address this question to Dallas Peck whom I admire very much for his excellent leadership to the Geological Survey. We are proud to have a public servant with the character and perseverance that Dallas possesses and I also see that Al Watkins is here and we welcome him.

Al was the Director of the EROS Data Center for 19 years. I know of no other person in Government with a greater command of U.S. land remote sensing policy than Al. I appreciate your both being here.

Dallas, S. 2297 mandates Landsat data be available at marginal cost. Others suggest a multitiered approach. How would the different pricing policies impact our Nation's archive of environmental data?

Dr. PECK. Senator, let me turn that over to Al Watkins. He is far more knowledgeable on the subject than I.

Senator GORE. If you could identify yourself with your title for our reporter.

Mr. WATKINS. Sure, Senator. I am Al Watkins, Chief of the National Mapping Division of the U.S. Geological Survey and as you said, ex-head of the EROS Data Center.

Regardless of the outcome of the pricing provisions of the legislation, it is, I think to all of us, vital that all data from the satellites flow into the archives so that 5, 10, 20, 30 years from now, we still have that baseline, an assured baseline of conditions on the surface of the Earth that are so vital as Dr. Fisk and Dr. Peck have described.

Who knows what future changes will occur in legislation or contracts, that kind of thing. So, it is clear that the archive needs to receive that kind of data, needs to assure its maintenance appropriately and needs to do that at minimum cost to the Government. So, pricing policy, whatever derives from the legislation or contractual negotiations, really needs to minimize the cost to the Government archive and to the Government as a whole.

Senator PRESSLER. Now following up on that, some suggest that we require Landsat data to be made available to the Government and global change researchers at the cost of fulfilling user requests. I believe this may allow some lawyers to successfully argue that this definition covers all costs including satellite operation costs.

What would be the impact of this definition on data price for the Government?

Dr. PECK. Well, one has to reach a decision about exactly what is covered and what is not. I would hope, frankly, speaking from my own personal background, that it is done at truly the marginal cost of filling one additional order.

But much of this is covered under new circular 130 which applies that same general policy to all Government data.

Dr. PECK. Let me just amplify on that. The circular A-130, as well as the policies on global data policies as described in the principles that Dr. Bromley's office has issued, uses the word "marginal" or "incremental costs." I mean, if the question is, could you amortize the cost of the satellite by your data policy, then we would be right back into the soup that we have been in on Landsat to date. You would simply price the use of this data beyond the means of the people who want to access it.

So, the clear intention has to be that it is basically the cost of generating a tape or sending a photo and that is the cost to the user.

Mr. FAGA. But be careful because here is exactly the kind of reason that the administration in this and in typical cases recommends against being too precise in the legislation. It could well happen that the system we have budgeted which is to be provided with public funds and for which a certain budget is provided does not fit certain niches that people would like filled.

For example, Mark Brender might come forth and say, "We love this Landsat data and the arrangements we have for it, but we want it a lot faster and would be perfectly willing to invest in equipment within the system that would provide the data that we want quicker." We would not like to be a situation where we say, "Well, we are not allowed to do that because by law we can only sell it at marginal costs."

Likewise, you might see some kind of capability on the satellite beyond anything DOD and NASA was interested in that other groups might want to provide for and you would want to permit that.

Senator PRESSLER. Now for Landsat 6 data, the archive can receive data at the cost of reproduction. If the Government tasks the satellite for the archive, what price will be charged?

Dr. FISK. All of those, I think, Senator, are going to be subject to negotiation with EOSAT Corp.

Senator PRESSLER. Dr. Fisk, we welcome you here and we thank you for your great public service. The national space policy, directive 5 states that "the U.S. Government shall promote and not preclude private sector commercial opportunities in Landsat-type remote sensing."

Yet we have seen over the past several years a commercial Landsat operation, a situation where researchers have been denied access to essential data because of the high cost. How can we meet

the needs of science and still meet the goal of commercial involvement?

Dr. FISK. Well, again, in the particulars with regard to Landsat 7, where the situation is clear, essentially the policy shift that is being made here in regard to commercial users is to say that the real market exists in or an enhanced market, put it that way, will exist in value-added industries, processing and enhancing Landsat data. That is a commercial market there.

So, the policy is, you make the data available to everyone at the marginal cost of reproduction and then you assume that the industries will develop by taking that data and enhancing it and make it more user friendly.

When you think about this, if you are a water district some place, you do not want to set up to take unenhanced Landsat data and try and process that. So there is clearly a commercial market available with somebody taking Landsat data and tailoring the product of that for a particular user needs out there.

The research community in contrast is already set up to take this unenhanced Landsat data and turn it into the research products that they want. So, I am actually quite optimistic that in this new approach, the research users needs are satisfied because they get the cost at marginal cost of reproduction and the value-added industry in remote sensing needs are serviced because they get it at the same price but then they add to it and sell a product which is useful to a broad market.

Senator PRESSLER. One further question, title 1, section 202, subsection a(1) of this bill, of S. 2297 specifies that the cost of Landsat data not exceed the marginal cost of filling a specific user request.

Now, as you see it, how does the intent of this section differ with OMB Circular A-130?

Dr. FISK. I do not think the intent differs. I would just echo Marty Faga's comments, that by putting it in law like that, then there may be cases where you want to do something that is different, that is not a violation of the principles, but you may want to pay some extra money to get something that is not available in a normal sense, and by having it in regulation and not in law, the Government retains the flexibility to do that.

If it was necessary for even small changes to come back to amend the law, that would of course inhibit the process substantially.

Senator PRESSLER. Now my bill provides for Government ownership of all unenhanced data required by the Landsat system and that no exclusive marketing rights are extended to any contractor. If this section were made law, how would this affect NASA's negotiations with EOSAT?

Dr. FISK. Let me make sure I understand the question. If it is in regards to Landsat 7, then I believe the EOSAT Corp. and the Landsat 7 time frame could play a number of functions. I mean, they could be contracted with by the Government to operate Landsat 7, that is a possibility certainly. But they will probably fall more in the category of a value-added industry where they and other value-added industries take the data and make enhancements and they do not have exclusive rights to the data anymore than the others.

And so in regards—

Senator PRESSLER. On Landsat 6.

Dr. FISK. On Landsat 6, I am out of my expertise on the law here, but my assumption has always been that since by contract they have the rights to the Landsat 6 data, an existing contract, that really the best approach here is for the Government to negotiate the use of that data and at the best possible prices to the Government researchers and others.

Senator PRESSLER. Let me ask the Department of Defense representative, you have expressed here today concern that the defense oversight of Landsat data might restrict civilian access. What are your thoughts on this and do you support the guidelines included in S. 2297 for the transfer to NASA and DOD of Landsat operations?

Mr. FAGA. I only expressed the concern as one I know that is held by others, and to assure you that we have no interest in classifying the data. There could be circumstances, as are provided for in the National Security provisions in the Landsat Commercialization Act, where there would be a necessity to temporarily withhold certain data as in an active military campaign, but this has been a policy that has long been in effect and we do not see it going beyond that in the future by the mere fact of our involvement.

Senator PRESSLER. For the Department of Commerce, let me ask this question. The administration has articulated a position of promoting and not precluding private sector commercial opportunities in Landsat-type remote sensing. What is your view of the appropriate mix of Government and commercial involvement in the Landsat program? And what is the relative size of the value-added remote sensing industry in the United States in comparison to the annual sales volume of EOSAT?

Mr. FRELK. I will try to answer the first point. I think that the Landsat 7 satellite that you are referring to, I believe, is really going to fulfill an important U.S. Government need. That is why we are doing it. It provides for continuity of global climate change research. As far as commercial participation in the Landsat 7 satellite, I would see that as occurring primarily as a contractor on the development and production of the satellite itself.

When you talk about the value-added area, I would like to turn to my deputy to see if I cannot get some numbers for you on the value-added market annually, and see if he has something. And if not, we will get back to you in writing on the question. [Pause.]

Senator PRESSLER. Well, in the interest of time I am going to be asking several more questions for the record.

Mr. FRELK. The answer is that EOSAT generates revenues of \$30 million a year. The value-added area is somewhat larger than that, closer to \$100 million, as I understand it.

And getting to your point, as my deputy Scott Pace points out, what we do not want to do as a Government is pick and choose between areas. I think we want to promote both equally.

Senator PRESSLER. How many people are employed by each industry?

Mr. FRELK. That I do not know.

Senator PRESSLER. Let me ask you one more question here. I assume you are familiar with the Halbouty Report. Now Mr.

Halbouty's panel indicated that the viable commercialization of space in the shorter term, could only be realized through the development of a private value-added community. Are you satisfied that we have had optimal development of a private sector value-added community in recent years, and would not S. 2297 help this private sector grow?

Mr. FRELK. I think that the bill would help the value-added community grow, and I think that is an important thing. Whether we have done enough to help the value-added community grow, I think, is an open question. But I would venture to say that we could always do more to be helpful to the commercial areas, again whether it be the value-added community or those people involved in the distribution of the data.

Senator PRESSLER. This questions just occurs to me, maybe somebody can take off on it. How does the SPOT Image or the other systems that are developing in the world, how do they deal with this problem? Does anybody know for sure—in distributing pictures and how much they cost to groups that are of limited resources? Al, do you know the answer?

Dr. PECK. Mr. Watkins can speak to this.

Senator PRESSLER. By the way, I walked into the space launch center down in French Guiana, and everybody knew you Al. They asked me if I knew you. [Laughter.]

So, I went up a notch, so you are a famous man down in French Guiana at the launch center.

Mr. WATKINS. I do not know if that is to be proud of or not, Senator. I will comment on SPOT Image. SPOT Image operates in a very similar fashion, in terms of distribution policy, to EOSAT. They have use restrictions that prohibit the copying of the data. Their prices are—for a much smaller image—somewhat less, \$1,600, I believe, for a 60-kilometer by 60-kilometer scene, but it covers much less ground.

There is some difference, of course, in that CNES, the French space agency, pays for the total cost of the satellites and SPOT Image seeks to recover the cost of ground operations. That is very similar to the way that we have run 4, 5, and 6, actually.

Senator PRESSLER. Let me ask, I think, Dallas. Do you feel a contractor should have exclusive marketing rights to Landsat data?

Dr. PECK. I think this would be a strong disadvantage. And, again, I think we need competition by a variety of companies in this area.

Senator PRESSLER. Some people suggest we defer the pricing policy debate. In fact I think if it were not for this hearing, nothing would be happening in terms of issuing circulars or other things. But what I am concerned about is that there would be a gap in the archival data stream if NASA does not have sufficient budget to task Landsat 6 for archival coverage. Is this a possibility?

And, you know, we have all this data available and it is really not available to the people who want to use it most. And if we have a break in the stream, it is going to be very expensive to move and very costly to recover.

Dr. PECK. Certainly, from the standpoint of understanding global change and monitoring changes of the Earth's surface over time, it is a worry. We do need repetitive coverage, and there is a problem,

I think. My impression is that for Landsat 6, data will only be acquired if it is ordered. And so unless somebody is ordering the data, we will not have repetitive coverage.

Senator PRESSLER. Now, Mr. Peck, as the House bill is written, how would it affect our Nation's data archive?

Dr. PECK. I am sorry, I am not that familiar with how that bill is written.

Senator PRESSLER. You might want to submit a statement for the record on that.

[The information referred to follows:]

The House bill has no specific language requiring data to be provided to the National Land Remote Sensing Data Archive, nor is there any provision regarding the cost of data from Landsat 6 if purchased for the government Archive. If the government has to pay current commercial rates to the Landsat 6 operator for archive data, it will most likely preclude building a complete archive of Landsat 6 data. In contrast, the Senate bill does contain language that would require a copy of all Landsat data be provided to the archive, including data from both Landsat 6 and 7.

As mentioned earlier in this testimony, USGS believes that the issue of data pricing is highly complex and would prefer that the bill not contain provisions regarding specific data pricing policy. We hope that there can be a workable solution to the current problem of providing Landsat 6 data to the government at reasonable cost, which is not addressed in H.R. 3614. And we would also hope that whatever bill is enacted contains language that would ensure the provision of unenhanced data to the Archive at reasonable cost, and without restrictions on further distribution to the research community.

Senator PRESSLER. One final question, then I will submit some questions for the record. Under S. 2297 we provide the Government with ownership of Landsat data. What impacts will this have on our Nation's archive of data; to anybody?

Dr. PECK. Well, this will certainly allow us to build and maintain a good archive. That is going to be tremendously valuable over time.

Dr. FISK. I think it is important to note that the funding that is currently in the NASA budget for Landsat program, the 1993 submitted budget, allows us to essentially establish a major processing and archiving activity in the EROS Data Center.

And that is one of the reasons you see some fairly large numbers in that budget request extending over the next few years, is our anticipation that if you start using the Landsat system, particular Landsat 7, as a global change satellite as opposed to just a regional image by image upon request satellite, that the amount of processing data that is going to be necessary is very much larger. The data to be processed will be very much larger and the system will have to be sized to do that. I mean it is an interesting fact that Landsat 7, by itself, represents about one-third of the data that will come down from the EOS system.

Senator PRESSLER. Thank you, Mr. Chairman. I have some additional questions. I will submit them for the record. I want to submit the list of the about 25 organizations supporting this legislation, mostly environmental organizations. And the list is growing and it also includes the Farmers' Union, the National Congress of American Indians, the National Association of State and University Land Grant Colleges, and many many others—the National Association of Counties and so forth. Thank you very much.

[The information referred to follows:]

JOINT LETTER OF THE NATIONAL FARMERS UNION; AMERICAN FORESTRY ASSOCIATION; AMERICAN LIBRARY ASSOCIATION; ENVIRONMENTAL DEFENSE FUND; AMERICAN AGRICULTURAL MOVEMENT; UNIVERSITY OF CALIFORNIA; CONSERVATION INTERNATIONAL; IZAAK WALTON LEAGUE OF AMERICA; NATURAL RESOURCES DEFENSE COUNCIL; NEW YORK ZOOLOGICAL SOCIETY; WILDERNESS SOCIETY; WILDLIFE MANAGEMENT INSTITUTE; SIERRA CLUB; ANIMAL PROTECTION INSTITUTE OF AMERICA; INTERNATIONAL PRIMATE PROTECTION LEAGUE; SOCIETY FOR ANIMAL PROTECTIVE LEGISLATION; WHALE & DOLPHIN CONSERVATION SOCIETY; NATIONAL ASSOCIATION OF COUNTIES; NATIONAL ASSOCIATION OF STATE AND UNIVERSITY LAND GRANT COLLEGES; NATIONAL AUDUBON SOCIETY; NATIONAL CONGRESS OF AMERICAN INDIANS; NATIONAL FARMERS ORGANIZATION; FRIENDS OF THE EARTH; NATIONAL GRANGE; NATIONAL WILDLIFE FEDERATION; NATIONAL PARKS AND CONSERVATION ASSOCIATION; AMERICAN CETACEAN SOCIETY; EARTH ISLAND INSTITUTE; INTERNATIONAL FUND FOR ANIMAL WELFARE; INTERNATIONAL WILDLIFE COALITION; RAINFOREST ACTION NETWORK; AND WORLD SOCIETY FOR THE PROTECTION OF ANIMALS

MAY 8, 1992.

Honorable LARRY PRESSLER,
U.S. Senate,
Washington, DC 20510

DEAR SENATOR PRESSLER: On behalf of all of the groups listed above, I should like to express our thanks to you for introducing S. 2297, to reform Landsat policy. Your bill takes the straightforward logical path to reform by providing Landsat data to all Americans at marginal cost. We urge you to resist every attempt to alter essential provisions of S. 2297: that all unenhanced data generated, beginning with Landsat 6, be available at marginal cost, that no exclusive marketing rights be extended to any contractor, and that the federal government retain ownership of all unenhanced data.

We also want to tell you how pleased we are at Dan Nelson's handling of this issue. He has displayed a degree of courtesy and competence which is rarely encountered.

South Dakotans have a good reason to be proud of your leadership on this very important issue.

Kindest regards,

LELAND SWENSON,
National President.

Senator GORE. Thank you very much. I have just a couple of brief followup questions. Dr. Fisk, for the past several years you and other NASA officials have repeatedly said that there needs to be a modification of the Landsat data policy, to ensure that the archived data in the EOSDIS can be distributed to all users at the lowest possible cost.

Has there been any change in that view in respect of today's testimony? Will you need any legislation on data policy to make Landsat data compatible with NASA's plans for EOSDIS?

Dr. FISK. Essentially, the things we need are the change—I mean, NASA and DOD are going to be given the authority to be in charge of this. We are going to have contract negotiations with the current owners of the Landsat 6 data, and we are going to drive hard on that issue. And we need the general principles in regard to how we are going to do Landsat 7 data, and we are going to follow that up with good regulations and proceed.

But I think, given those sort of general statements, we have what we need and we are just as committed. I mean we think we have the answer now to this problem. Whereas before when we testified before you there were impediments. There was no continuity of the Landsat system, there were impediments to be able to do this. And we are very much with the legislation coming. We are on the right now track now, to be able to do this.

Senator GORE. With the legislation coming.

Dr. FISK. Well at the moment that is right. Remember, at the moment we do not—we have commitments on how we are doing Landsat 7, but the DOD and NASA are not in the driver's seat on this until the legislation changes.

Senator GORE. Now Landsat 6 data policy is quite important if launched, as now scheduled, in 1993 with a 5-year design life, perhaps more. Would you expect more?

Dr. FISK. Well, certainly, based on the Landsat 4 through 5—I mean the satellites tend to last much longer; yes.

Senator GORE. So, would you project 5 to 10 years?

Dr. FISK. I think so, but I would certainly only count on 5.

Senator GORE. Well at least until 1998 and maybe until the year 2003 or thereabouts. With the current contract, does not EOSAT have data rights for 10 years after the data is collected, possibly through the year 2013?

Dr. FISK. That is correct, sir.

Senator GORE. Does that make sense from a policy point of view? I guess we have asked that question before.

Dr. FISK. That is an existing contract. But I do not want to leave a misimpression. The discussions that we have been having informally at the moment, because NASA does not hold the contract on this, with the EOSAT Corp. have been very constructive. And I am very optimistic that we will have a good working relationship that will achieve what we all want on this.

Senator GORE. Is that partly because they are scared of Senator Pressler's bill?

Dr. FISK. I believe they are testifying later and you should ask them that question.

Senator GORE. What has NASA's response been, thus far, to these proposals from EOSAT?

Dr. FISK. At the moment, we have been very enthusiastic about it.

Senator GORE. But you have not accepted any of it.

Dr. FISK. But we are getting very close, and that is an ongoing negotiation on this. I mean let us be—the principles here are really kind of simple. You want the maximum coverage of the Earth, you want the minimum price to the researcher, and you want to make sure that the data is adequately archived and saved for future reference. You achieve those three things, then we have gone a long way toward solving this problem.

Senator GORE. If there is no statutory change in the way Landsat data is priced, NASA would begin buying the data from EOSAT under some arrangement that you negotiate. Is that what you anticipate?

Dr. FISK. That is correct; yes.

Senator GORE. How much data do you believe would be needed, and what would be the approximate total cost?

Dr. FISK. Let me not do a numbers game here, but let me—

Senator GORE. Well, we have to make up a budget. I mean we are in that time of year when the numbers game is relevant.

Dr. FISK. I understand. I mean the kinds of discussions that we are having at the moment include getting sort of 400 major scenes here. I mean this is, again, Landsat 4 and 5 that we are discussing, is existing data. But getting 400 scenes, and then, say, you would

get 300 tropical forest scenes and 100 of Eastern Europe, for example. And I am told that 300 tropical scenes will give you full coverage of the rain forest.

Senator GORE. 400 total.

Dr. FISK. Yes.

Senator GORE. And what do you expect the approximate total cost to be?

Dr. FISK. Well about \$1,500 each.

Senator GORE. What is the marginal cost of producing the scenes?

Dr. FISK. About \$500.

Senator GORE. So, you are paying 200-percent markup; is the good deal that you are getting.

Dr. FISK. The commercial price is \$4,400.

Senator GORE. I understand that. But from the Pressler legislation—compared to what it would be under the Pressler bill, it would be a 200-percent markup and this is the deal you are excited about.

Dr. FISK. I am more excited about that than paying \$4,400.

Senator GORE. OK. I just want to make clear that we have more than two options on the table.

Under the management plan for Landsat 7, NASA will be responsible for development and operation of the Landsat ground system. What types of facilities will be needed to carry out this management plan, and what level of annual funding will NASA need to carry out this plan?

Dr. FISK. The fiscal 1993 budget is \$25 million, and then it sort of stays at that level, with inflation over that, for some years. Included in that we have several responsibilities. In this we have the responsibility to provide a TDRS antenna to the Department of Defense, so that is included within that budget.

And then we are essentially sizing the EROS Data Center and the DAC, this a distributed active archives center for the EOSDIS, to be able to handle the Landsat data. And I think the sort of sanity check that you do those numbers is that you remember that, as I mentioned a while ago, this is about 100 gigabytes a day, is a potential data source from Landsat. So, you dealing with about one-third of the data stream that comes from all of the EOS satellite system.

Plus do you want to process this and turn it around in exactly the same way we would do all the EOS data on our typical turn-around times of 24, 48, 72 hours, depending on the product. And just in the same sense that we are building the EOS data system early to make sure it is ready on time, we are planning to build the Landsat data system the same way.

Senator GORE. Now one final question, for you Dr. Peck. Under S. 2297 the Government would likely assume responsibility for processing orders from a far greater number of users, due to the reduced cost of the scenes. EOSAT claims that this would lead to a delay in processing orders. They say—and I do not want to misquote them, I will let them speak for themselves on this.

But what I hear them saying, I think, is that they believe the EROS Data Center would not be able to process these increased demands in a timely fashion, nor would it be able to continue the

marketing successes that EOSAT claims to have achieved. I do not make that charge, those are not my words, but how do you respond to what I hear EOSAT saying about what they claim to be limitations at the EROS Data Center?

Dr. PECK. Well, part of this will involve building up capability to handle not only the Landsat data, but the EOSDIS data, as Len Fisk said.

Let me turn it over to Al Watkins who, having been director of that center for 19 years, has some knowledge of the system.

Mr. WATKINS. Processing of large quantities of data, Senator, is a problem. There is no question about that. It is a problem whether it is done in the Government or the private sector, either one. EOSDIS and the data coming down from EOS, as Dr. Fisk has said, will be three times the load from Landsat.

And I would like to also be sure we recognize that there are ways that we can work in partnership with the private sector and still retain increased Government policymaking—and I think that is what some of the panel is getting to here—in terms of control of pricing, and in terms of control of distribution restrictions, but not precluding some effective partnerships with the private sector, particularly in the value-added area, that would lead to competitive marketing of the data in an effective way.

Senator GORE. All right, very good. Let me thank all of you. And did you have any other questions?

Senator PRESSLER. I do have some for the record.

Senator GORE. All right. We will have other questions for the record.

Thank you all for staying with us and for the fine work that you all do.

I would like to ask our second panel to come to the witness table. Dr. David Thibault, Executive Vice President of the Earth Satellite Corp., and Dr. Brent Blackwelder, Vice President for Policy with Friends of the Earth here in Washington, Dr. John R. Jensen from the Department of Geography at the University of South Carolina—he is Carolina Research Professor there—Ms. Charlotte Black Elk from Manderson, SD, and Dr. Frederick Henderson III, President of the Geosat Committee in Norman, OK.

If all of you would come to the witness table, and if we could make the transition with as little disruption as possible, before we begin this panel I would like to say to you, Dr. Jensen, a special word of welcome and tell you that the chairman of our committee, Senator Hollings, had intended to be here to welcome you to this panel in person, but another committee is marking up important legislation right at this time and he cannot be in two places at once. He had to be in that markup, as the interests of our country and I am told South Carolina as well are in play there. But he wanted me to extend a personal welcome to you as a member of this panel.

We are going to begin in the order in which I introduced the witnesses. Mr. David Thibault, as I said, is Executive Vice President of the Earth Satellite Corp. based in Rockville, MD. We are going to maintain the 5-minute rule. Your full statements will appear in the record and will have an effect on our consideration of legisla-

tion, so please confine yourself to a 5-minute oral presentation. If you would kick it off, Mr. Thibault, welcome.

**STATEMENT OF DAVID A. THIBAULT, EXECUTIVE VICE
PRESIDENT, EARTH SATELLITE CORP.**

Mr. THIBAULT. Thank you, Mr. Chairman. Earth Satellite Corp. is a value-added company. We have been in business since 1969, and I can speak for one value-added company, having spent most of my professional career there. We endorse S. 2297. I think you can increase the number from 25 to 26 organizations that are in support, and I know there are many other value-added organizations which will be speaking out in support of this legislation in the weeks ahead.

I would like to address several topics that are contained in S. 2297 and are also dealt with in H.R. 3614. I think that there was a comment made earlier about stupidity in original Landsat commercialization legislation, and I would say that memorializing that program does not make it a wise program. H.R. 3614 is flawed in many respects, and I would like to speak specifically to issues that have been raised here this morning and which are vital to the value-added community. The first has to do with multitiered pricing.

EarthSat and other value-added companies compete for much of their commercial business with private nonprofit corporations, with Government institutions, and with other organizations which we believe would qualify for reduced price data under the scheme suggested in H.R. 3614.

In fact, the definition of "commercial" is a very difficult one to make. At the present time, we are conducting research on the spectral signatures of oil slicks that has potential value for environmental protection. It also has great value for the location of oil and gas. One does not know, when research begins, what the ultimate outcome of that research will be and what the benefits might be. Indeed, some may be public, or as is more often the case the benefits are likely to be public and private. We believe that two provisions of H.R. 3614 are fraught with difficulty. They fatally flaw the two-tiered pricing concept, and those are the provisions which call for foreign participants in the EOS program to be designated as affiliate users with the U.S. Government.

The second provision of H.R. 3614 which causes great difficulty, though we think it makes sense in terms of data use, is that which allows the Government and affiliated users, global researchers and so forth, to reproduce Landsat unenhanced data without restriction. The absurdity of a program which will police noncommercial data after those data have been made freely available to any nation in the world and may be reproduced without restriction by any recipient is clear.

The program which is implied by H.R. 3614 requires a level of policing that will be onerous to the data recipients, to the administrator of the program, and certainly to those discriminated against in terms of price. We suggest, as several people have said this morning, that simple pricing policy be adopted. There is a simple pricing policy. It is contained in S. 2297. It is simple, it is clear,

it is equitable, and we believe it makes economic sense and it makes administrative sense.

It makes economic sense because if commercialization fails from anything at present, it fails from the same lack of access to data that afflicts the research community. We believe that the appropriate approach is to make data available to everyone. Then we will see a growth in the commercial use of the data as well as a growth in the research use.

The question was asked as to what is the size of the value-added industry. It is an industry which by our experience has sales in a range of about 10 to 20 times the data costs, so if you assume Landsat and SPOT sales were on the order of \$60 million last year you have a very large industry employing many people in large and small organizations. We think further encouragement of this industry is warranted.

Finally, I would like to speak with respect to some provisions which are contained in H.R. 3614 and S. 2297. We support strongly the Landsat archive initiative. We have time and again turned to the EROS Data Center for historical data. It is critical that that center continue to maintain those data.

We support the Technical Advisory Council called for in H.R. 3614. We did not hear much in the first panel about the interest of the private sector. Those interests are real, they are important to this Government. Finally we are participating in a program with the U.S. Department of Defense on Senator Gore's dual-use initiative, which seeks to bring together a civil and defense communities, academia, and the private sector to gain the greatest benefits from technologies which exist in our Government. We think the same principles should be applied to the Landsat program.

Thank you.

[The prepared statement of Mr. Thibault follows:]

PREPARED STATEMENT OF DAVID A. THIBAUT

This testimony is presented in two parts: the first offers our views on the legislation before the Congress, S. 2297 and H.R. 3614; the second provides a review of the last 20 years of space and airborne remote sensing and a view of the future from the perspective of a value-added company.

I. THE LEGISLATION

There are five principles which we believe must be embodied in a land remote sensing act:

1. Open skies as provided in the Land Remote Sensing Commercialization Act of 1984.
2. Non-discriminatory access to data.
3. Program continuity.
4. Service (to the extent that this principle can be mandated, it is we believe covered by non-discriminatory access).
5. Technological progress.

We believe that S. 2297 deals fairly and effectively with each of these principles. By suggesting discriminatory pricing and data access, H.R. 3614 threatens the viability of a small but growing value-added industry for the sake of a failed initiative (commercialization) and a mythical revenue windfall.

Commercialization

The Land Remote Sensing Commercialization Act of 1984 was a desperate and effective means of saving the Landsat program. It worked. However, our forecasts of commercial viability erred greatly. Experience disproved the commercialization theory. The retention of some elements of commercialization in H.R. 3614 is difficult to support. The government may, if it chooses, have a commercial organization or

organizations involved in any or all aspects of the program, but it cannot choose to make the program commercially viable. It is not. And, save an act of the Almighty, it will not be in the next 10 years. The reason it cannot be viable in the near term is simply one of profits. If we assume the life of a satellite to be five years, and the cost \$500 million, and profits on data sales to be 10 percent of revenues, commercial users will contribute about \$600,000 (sales to commercial organizations are less than \$6 million) a year in profits toward the building of new satellites (assuming that all profits are reinvested). Commercial users will contribute less than 196 to the cost of new satellites. The obvious truth is that in the next 10 years, commercial users will not contribute significantly to the cost of future Landsat's.

Marketing of Unenhanced Landsat Data

S. 2297 provides for Federal "ownership of all unenhanced data acquired by the Landsat system * * * and that (2) no exclusive marketing rights are extended to any contractor; Title I, Sec. 202(b)(1)(2). This provision makes good sense. As we have seen with census data, competition in the repackaging, marketing and sale of the raw census data has offered consumers a wide variety of products at very competitive prices. A government sanctioned monopoly will assure high prices, poor service and limited products. Competition is healthy. The government should provide minimally processed data to all purchasers and not restrict the marketing of those data as provided in S. 2297.

Value-Added Services

In tacit recognition of the failure of Landsat commercialization and explicit acknowledgement of the bankrupt economics of two-tiered pricing, H.R. 3614 invites the Landsat program managers to "explore revenue-enhancing activities" in its negotiations with the Landsat-6 contractor. Title I, Sec. 203(b)(5).

Included in this "exploration" is the possibility that the Landsat-6 contractor "may include value-added services" in these revenue enhancements. The Landsat Commercialization Act of 1984 does not preclude the operator from value-added activities. it attempts to provide, as does H.R. 3614, safeguards against the contractor using its extraordinary position to unfairly compete with other value-added users. In fact, the safeguards have failed. EOSAT offers value-added products, and has done so in a manner that contravenes the intent of the 1984 Act. It's unlikely that given the self-acknowledged economic shortcomings of H.R. 3614, that the contractor will behave differently in the future. But, there's more than economics to concern us.

Since the contractor schedules satellite data acquisitions, he may favor his data needs for value-added services over his competitors. Such a threat imperils every value-added company. The contractor also has the names and geographic areas of interest of all purchasers of government provided Landsat data and may use this information to market value-added services to those purchasers. This information has never before been disclosed outside of the EROS Data Center and EOSAT and failure to honor the proprietary nature of this information carried serious penalties. Since we testified to the House on June 21, one of EOSAT's parents has acquired a value-added company and has moved aggressively into the value-added market. The possibility for abuse by the contractor of its unique position is real. H.R. 3614 encourages the establishment of a government-sanctioned vertical monopoly which will hurt consumers, the value-added industry, and the government.

S. 2297 deals with this potentially destructive provision simply and effectively by not granting "exclusive marketing rights * * * to any contractor." Title I, Sec. 202(b)(2).

We believe that expansion of the commercial market is best served by nondiscriminatory access to minimally processed Landsat data at marginal cost.

Multi-Tiered Pricing

H.R. 3614 proposes that unenhanced Landsat data may be offered for "non-commercial" uses at one price (i.e., "the marginal cost of fulfilling a specific user request * * *"), and at another price to "commercial" users of the data. Let me be clear, H.R. 3614 does not mandate multi-tier pricing, it simply authorizes the Landsat Program Manager to negotiate this matter with the Landsat-6 contractor. EOSAT has made it clear in congressional testimony² and in its advertising that it favors multi-tiered pricing.

¹Silvestrini, A. "The Landsat Program: Management, Funding and Policy Decisions" presented to the Committee on Science, Space, and Technology, U.S. House of Representatives, 26 November 1991.

S. 2297 wisely recognizes the long established and well founded principle of "non-discriminatory access to data."

We support the argument that Landsat data should be provided to organizations participating in global environmental research at a low or marginal cost. We believe further that all land remote sensing research would be stimulated by lower data prices and support this concept.

The suggestion embodied in H.R. 3614 that these high public purposes be met by a multi-tiered discriminatory pricing scheme is, however, a fatally flawed concept. It fails on economic, operational, and equity grounds.

Since H.R. 3614 begins with definitions, let me begin with a request for a definition of commercial use. While it is easy to identify a government agency or a non-profit corporation, it's not so easy to define commercial use. If research has no commercial objective, why should we be interested in subsidizing it? In fact, all research has a commercial objective--sometimes that objective is primary and is obvious. A better means of finding oil or managing private forests is clearly commercial. But let's assume for a moment that Exxon contracts with the University of Texas to conduct research on the spectral signatures of naturally occurring oil slicks in the coastal waters of the United States (EarthSat is currently conducting such research). This research may lead to improved methods of finding oil from natural seeps (clearly a commercial purpose) or may be used to mitigate the effects of oil spills (a public purpose with a strong commercial component). When the research begins, the course and the benefits of that research are hypothesized, but they are not known.

The definition of commercial use is, I believe, further clouded by the economic nature of private nonprofit organizations. Such organizations provide employment, purchase goods and services, provide goods and services, contribute to the economy and to the balance of payments. They distribute their income to their employees, rather than to stockholders, and they don't pay taxes. Only in their legislative exemption from taxes are these organizations commercially different from profit making organizations. I believe that the handful of tiny for profit corporations which make up the value-added remote sensing industry will be destroyed by this provision of H.R. 3614. For every segment of our business, EarthSat must compete with government and nonprofit organizations. If commercialization remains a purpose of a new Land Remote Sensing Act, then discrimination against commercial organizations is at least inappropriate. Because such definitions are difficult, enforcements will be cumbersome and costly, leaving the beneficiaries of the lower price, those discriminated against, and the administrators unhappy.

The language of H.R. 3614 suggests that public purposes have a higher calling for data than private for profit purposes. This is not explicit, though a lower price for "state and local government agencies * * *" is suggestive of this conclusion. Favored treatment for Federal agencies might also be argued on a different basis. But, regardless of the justification for this discrimination, it presents problems. If the Corps of Engineers, pursuant to the National Environmental Policy Act, were to prepare an environmental impact statement for a waterway improvement project, and chose to use Landsat data, they would get the data at marginal cost. A worthy public purpose, a good use of the data, a benefit to the program and society. If, however, EarthSat and Dames & Moore (a large engineering company) should use Landsat data to prepare an environmental impact statement for the Idaho Power Company for a 1,500 mile transmission line in the western United States, they would pay full price for the data (perhaps 5-10 times what a favored user would pay) to serve the same public purpose. This project did take place, and because of the use of satellite data, the licensing time was cut in half. These applications may be discouraged by unfair pricing because value-added companies will not be competitive with favored institutions.

Having defined commercial use, the question which follows will be: What regulatory assurances will the Congress provide those few users who must pay full price that they are not being competitively disadvantaged by well or ill-intentioned academics or nonprofits?

As a commercial user, EarthSat will insist upon meticulous accounting of non-commercial data, and we will use all available legal means to assure compliance with the "non-commercial use" mandate. EarthSat's principal competition for commercial products and services comes from nonprofit institutions and organizations, and government agencies, so our vital interest is affected by this provision of H.R. 3614.

Enforcement is further compromised by two provisions of H.R. 3614:

1. "the term United States Government and affiliated users means—* * *

1) international entities who have signed with the United States Government a cooperative agreement involving the use of Landsat data for non-commercial applications," Title I; Sect. 101; 12(D), and

2) "(b) Considerations—In carrying out negotiations under this section, the Landsat Program Management shall * * *

"(3) ensure that the United States and its affiliated users shall not be prohibited from reproduction or dissemination of unenhanced data to other such parties as long as the unenhanced data will be used solely for non-commercial purposes;" Title I; Sec. 203(b)(3).

I am sure that the absurdity of restricting use while allowing unrestricted copying and worldwide dissemination of the unenhanced Landsat data is apparent to all who give this issue a moment's thought. I might note that the memoranda of understanding between the United States and foreign governments which license the direct receipt of Landsat data have been widely dishonored by our foreign partners.

There are other operational realities of multi-tiered pricing:

1. The contractor must establish a procedure for assuring compliance, and put in place a staff to deal with the record keeping.

2. The government must establish an enforcement office.

3. Recipients of non-commercial data must establish procedures to assure compliance, and assign staff to prepare compliance or audit reports. The sanctions are severe and leakage very possible, so it would be highly imprudent for an institution not to go to great lengths to protect itself.

4. Everyone will have to hire lawyers (I do not consider this a benefit, though some may).

Multi-tiered pricing will be an operational disaster.

We know from experience that other governments share data that has commercial intelligence value (and Landsat certainly qualifies) with commercial organizations. This is particularly true of the Japanese who do not distinguish between the government and private sectors when the objective is the exploitation of another nation's natural resource wealth. I support the Japanese cooperation between government and industry in international trade. Indeed, I am envious. Failing such cooperation from my government, I hope that you will at least not provide commercial intelligence to our international competitors at one-tenth the price American companies must pay.

There are other arguments against multi-tier pricing. Gresham's Law will surely apply. The low priced product will drive out the high priced product. One of the values of high priced data is that it dampens demand. When the data were free to ERTS-1 and 2 Principal Investigators (1972-1975), we ordered thousands of scenes. EarthSat alone ordered more data than the Landsat-6 facility can produce. As the price goes down, demand will go up, revenues will go up, and system costs will go up, but it's not likely that benefits from research will grow proportionately.

We have tried to construct alternatives to the non-discriminatory access provision of the current Act. There aren't any. They fail on economic and operational grounds. The concept is inequitable and unenforceable.

If the purpose of multi-tiered pricing is to buy out EOSAT, as might well be inferred from the Committee Report on H.R. 3614, then we must ask why a few Landsat data users must pay the full price for the failure of the commercialization initiative.

S. 2297 deals simply and effectively with the pricing problem by providing that "Any unenhanced data * * * shall be made available to all users on a non-discriminatory basis. * * *" Title V, Sec. 501(a).

Pricing

If we reject multi-tiered pricing, we must then decide whether the single price should be high, low, or somewhere in between. Let me first say that the Congress should not attempt to be too specific on this matter. The market and operational costs should be considered in price setting. We believe that prices should reflect the marginal cost of producing the product. Since both S. 2297 and H.R. 3614 recognize the failure of commercialization, commercial prices are inappropriate, unless the intent is to provide windfall profits to the contractor. If the government's objective is a social one as with most public programs, then the price should be low enough to assure broad distribution and use of the data with perhaps some partial cost recovery above and beyond reproduction cost. Data from the Decennial Census, which cost \$2.6 billion, are distributed to public and commercial organizations at a nominal, uniform price. Revenues fall far short of paying the cost of the Census, but it is clear to most that there are public benefits in addition to the Constitutional requirement which warrant Federal expenditure. The fact that commercial organizations (i.e., in marketing and direct mail sales) are major beneficiaries of this Federal

data collection and dissemination effort does not weaken the argument for public funding. The analogy to the Landsat program is a good one.

In 1982, the Land Remote Sensing Satellite Advisory Committee, chaired by Michael T. Halbouty, in its report to Secretary Baldrige stated that the key to successful commercialization " * * * is data availability. * * * " Clearly, if the government wishes to encourage the use of Landsat data, price is a key. We support the provision of S. 2297 which calls for the cost to users "not exceed the marginal cost of filling a specific user request." Title I, Sec. 202(a)(1).

Finding (9) of H.R. 3614 "the high cost of Landsat data has severely impeded the use of such imagery for scientific purposes" might also read, "the high cost of Landsat data has severely impeded the use of such imagery for commercial purposes." Perhaps the stimulus the commercial market needs is marginal cost data.

Technological Progress

Both S. 2297 and H.R. 3614 address the important matter of Research and Development. Land remote sensing is young technology with much promise for both public and commercial applications. Potential private industry potential contributions are not simply limited to commercial applications. On large construction projects, industry is required to comply with Federal and State environmental regulations and to mitigate the adverse environmental impacts of these projects. Satellite data are contributing to these projects. More is possible. The research has both public and commercial benefits. That research may suggest new sensors, changes in the spatial or spectral resolution of sensors, and different acquisition and processing parameters. H.R. 3614 provides for a biennial review of the Landsat program which would receive the comments of industry, government and academia. We believe this review is essential and the Landsat Advisory Council provided for in H.R. 3614 could make significant contributions to the advancement of land remote sensing technology.

Federal Responsibility

We believe that the arrangements proposed in S. 2297 and H.R. 3614 for managing the Landsat program can succeed if the Executive continues to back its advocacy of the program with adequate budget requests.

LAND REMOTE SENSING—AN EMERGING TECHNOLOGY

The Gulf War demonstrated to the military and intelligence communities what the civilian commercial users of Landsat data have known for more than a decade. Landsat and SPOT can provide accurate, current information on land cover, natural and cultural resources for large areas, for inaccessible remote regions, and can do so quickly and inexpensively.

My testimony will focus on three commercial activities which we believe will be at the center of commercial applications of earth resource satellite applications in the next decade:

1. Global environmental monitoring
2. Mapping
3. Resource exploration

I have also included information on developing country use of satellite data because of the economic and social importance of these activities.

Each of these activities will rely increasingly on satellite data and each offers substantial benefits to the U.S. economy. Before examining these applications, I would like to briefly recount EarthSat's Desert Shield and Desert Storm experiences because our contributions were made possible by vigorous technological developments spurred by private sector business. In 1990, less than 8 percent of EarthSat's business was with the Federal Government.

Desert Shield and Desert Storm

On July 15, 1990, EarthSat completed a major petroleum exploration study for the Northern Arabian Platform which includes all of Kuwait and Iraq, and parts of Iran, Saudi Arabia, Turkey and Jordan. Our clients for this study were international oil companies. On August 3, 1990, following the Iraqi invasion, we offered to provide the U.S. Government with current satellite-derived image maps of the Gulf area within 48 hours using SPOT and Thematic Mapper data. Our proposal fell on deaf ears. It apparently failed for two reasons: (1) the government was satisfied that it had adequate maps, or that it could produce them, and (2) the government experts were convinced that what we proposed could not be accomplished in time to be useful, let alone in 48 hours. Having failed to uncover an interested agency or official, EarthSat abandoned its marketing efforts about a week after they began, and refocused on its commercial markets.

In early September, early on a Monday morning, we received a telephone call from one of those government officials we talked to in the first week of August asking whether we were available to produce image maps and could we do so quickly. Apparently, existing maps were not entirely adequate. What followed were several projects in which we produced:

(1) 46 image maps (scale 1:50,000) from pre- and post invasion SPOT 10 meter panchromatic data. One of EarthSat's staff went to France to pick up the SPOT data to accelerate the process. The maps, along with stereo imagery for terrain analysis and trafficability studies, were produced within 48 hours of receipt of the data and in less than one week, including the trip to France.

(2) 33 multispectral image maps (scale 1:100,000) from Landsat Thematic Mapper data. These maps were produced in 36 hours.

(3) 100,000 lithographed copies of the 33 multispectral image maps. Production time: 4 days.

The capacity to respond quickly to the government's requirements was developed in response to the civilian commercial market demand for rapid service, complex products, and the highest possible quality. Apparently, none of the existing government contractors or responsible agencies were able to meet the operational requirements of the Desert Shield forces. Let me add that our efforts received the strongest support from the government, and without this active participation, we could not have met our objectives. Examples of these products are on display.

EarthSat's support of Desert Storm included rapid turnaround (6-12 hours) of satellite images utilizing a variety of proprietary processing techniques and algorithms developed for commercial applications. While all the image processing involved interactive computer analysis by geologists, geographers and other earth scientists, final photographic products were produced for the client's interpretation and analysis. (164 images were produced from SPOT and Landsat data during the war.)

My purpose in recounting this experience is not to call attention to our accomplishments vis-a-vis the government, though I am certainly proud of these accomplishments. My purpose was to note the benefits the country may derive from vigorous private sector activity and to caution against condemning future Earth observation programs to public agencies by discriminatory data access.

Global Environmental Monitoring

If the EOS program goes forward as it is currently planned, it will in time provide essential data on the health of the planet. From these data, scientists will construct mathematical models which will describe global environmental processes, and we will be capable of predicting the long-term effects of man's activities on the environment. This necessary basic research will almost certainly provide significant benefits to mankind in the 21st Century, but it will not deal with the serious and persistent environmental problems which today plague the Earth. Fortunately, Earth sensing from Landsat, SPOT, MOS and a host of satellites to come, will fill that need, provided that government has that wisdom to retain these instruments which have served well and can continue to do so. Much of the environmental work with which EarthSat is involved utilizes satellite data to monitor change in land use. We know that if forests are being cleared in the humid tropics for timber or agriculture, there will be local and global environmental consequences. Today, regulation of this one activity relies upon satellite data in a number of countries. Urban pressure on agricultural land is routinely observed by development planners in Asia, Africa, Latin America and governments in the industrialized countries. Vegetative stress from air pollution is monitored in Europe and North America. Environmental planners utilizing geographic information systems employ satellite data in their models to anticipate the impacts of change and infrastructure investments. Most of the hardware and computer software for these applications was developed by private companies in the United States. This development has created a growing market for satellite data, and growing benefits to society.

If the global environmental monitoring program envisioned by NASA, NOAA and cooperating domestic and foreign organizations succeeds in increasing our knowledge of the Earth's environment, in educating the world's population on the necessity for conservation, and in motivating our political institutions to make the hard choice between near-term and economic advantage and a better environment, we will still need land satellites to support the job of cleaning the environment.

The following examples of recent environmental work completed by EarthSat suggest the great potential of land remote sensing for understanding and ameliorating the problems which increasingly plague our planet.

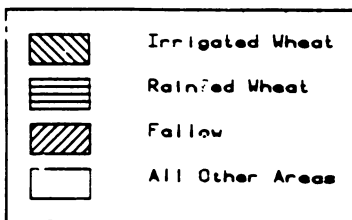
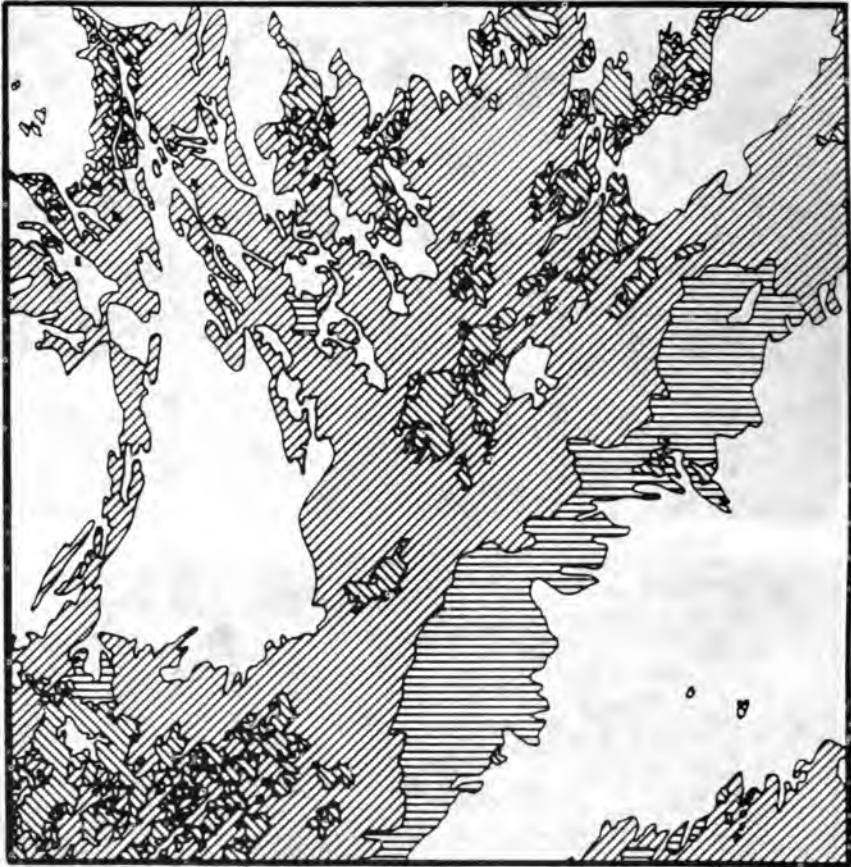
Egypt, Nile Delta Land Use Change Analysis.—Extensive land use changes in the Nile Delta region were identified from an analysis of enhanced, multi-date satellite images by Earth Satellite Corporation. A dramatic visual records the impact of pop-

ulation growth on land use patterns, specifically on the loss of agricultural land. It also depicts the effects of urban expansion on agriculture, desert and water, over an eighteen year period. Land classification and change analysis techniques were applied to processing a six-scene mosaic.



Poland, Environmental Monitoring of the Silesia Region.—In an effort to study the effects of airborne pollutants on vegetation in the Silesia Region, Earth Satellite Corporation processed and analyzed Landsat TM and MSS imagery. This small, heavily industrialized region produces 98 percent of Poland's coal which, when burned and combined with water, produces acid rain. The effects of this and other airborne pollutants are especially evident in Poland's forests. Over one-half of Poland's forests are dead or dying. Earth Satellite Corporation developed vegetation indices which show a decline in biomass and vegetation vigor in forested areas. Land use/land cover and change images also show a high correlation between declining biomass and proximity to industrial areas. Analytical results of this study were presented in a SPANS-Geographical Information System (GIS) format.

EXISTING AGRICULTURAL INVENTORY MOQUR, AFGHANISTAN

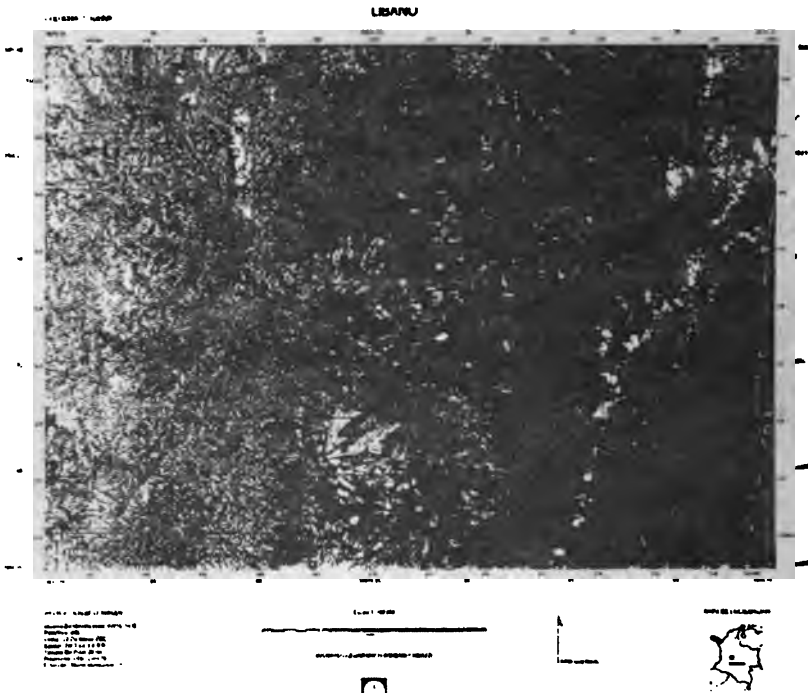


0 Scale 10km





Colombia, Instituto Geografico Agustin Codazzi (I.G.A.C.).—Successful applications of remote sensing and GIS technology require well-trained local scientists. The I.G.A.C., in an effort to strengthen its remote sensing program, has retained the experience and expertise of Earth Satellite Corporation. EarthSat scientists are providing training and technical assistance for post-Masters level scientists, in Colombia. The project has three major components: 1. University training of ten Colombian scientists. 2. Procurement of state-of-the-art digital remote sensing and GIS hardware and software. 3. Implementation of pilot GIS project in the Department of Tolima, Colombia, which is currently being used in a landmark project for its level of sophistication and funding.



Mapping

Map requirements vary widely. It would be a error to conclude that developed countries are well mapped and that developing countries are not. It depends upon the requirements of the users, and not some theoretical definitions of scales and accuracies, themes and presentations. Many map user requirements can be met by Earth satellite data, or a combination of satellite data and existing maps. Standard 1:24,000 scale USGS topographic maps of the southeastern U.S. updated in the last 10 years may be useless to a public utility which needs current information on land use, urban and rural development, and the location of new roads. EarthSat is producing such updated maps from 10 meter SPOT panchromatic data at a cost to our commercial customers of \$500/map. The update is produced in 2 weeks and relies on the existing USGS map for geodetic accuracy. An update by the government would take 3 to 5 years and cost about \$10,000. In many respects, it would be a better product, perhaps better beyond the needs of a particular user. In one respect, it would be a poorer product; it would be 3 years out of date by the time it was released. A nation may be mapped in days with satellite data as was done during Desert Shield or in weeks as we are currently doing for the government of Afghanistan. For the FAO, EarthSat is producing a national map series from Landsat TM data; 83 image maps at a scale of 1:100,000 covering the entire country will be produced in 5 weeks. These maps will be lithographed at 1:250,000 scale for wide distribution. The cost of this national map series will be less than \$2,000/map. Lithographed copies will cost less than \$3.00. The maps will be used for damage assessment, redevelopment planning, and agricultural development. These are just two examples of the dozens of different kinds of satellite-derived maps being used by public and private organizations in the U.S. and abroad. While these image maps are not an adequate substitute for medium to large scale topographic maps, they service many purposes well, can be produced instantaneously, can be directly imported into computer data bases, and are very cheap.

Resource Exploration

Of all the commercial applications of Landsat data, resource exploration is probably the best known, most widely discussed, and least understood. The perception that satellite data alone can locate minerals, hydrocarbons, ground water or arable

is at best an over simplification. Satellite data are powerful and valuable tools in a growing community of users in what has recently become a rapidly changing world. Political developments in the Eastern Bloc have highlighted one of the great values of satellite data; the ability to provide extensive information on areas quickly and inexpensively. Regional resource exploration in the Soviet Union and China has relied heavily on Landsat data for geologic mapping, regional analysis, and exploration planning. While satellite data represent a very small percentage of the information the explorationist must consider before purchasing mineral rights or drilling a hole, they may represent the most cost-effective exploration expenditures. The following are two examples of recent hydrocarbon studies completed by EarthSat, and one about to be initiated. The economics speak for themselves. Figure 1 is an example of one of these studies.

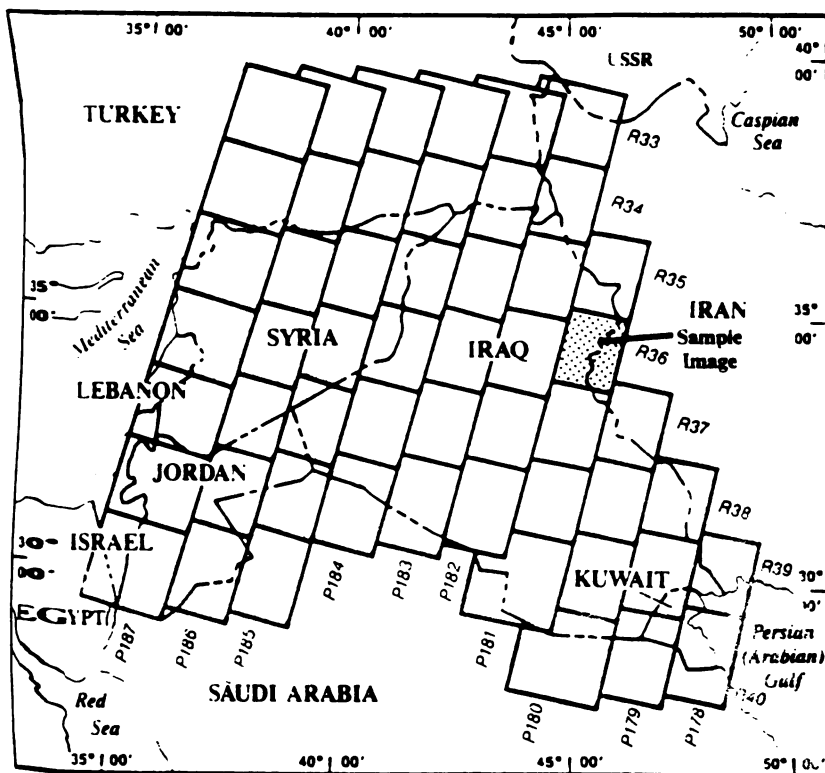
Mongolia, Figure 1 (completed, June 1991). Opportunities for western investment in Mongolia are most recent. This geologic study, which covered an area of 245,000 square miles, relied heavily on Landsat data. It was completed in 6 months. Clients of this nonexclusive study received a detailed technical report, satellite imagery, geologic interpretative overlays, a detailed bibliography, and supporting geologic information. The information presented is the first of its kind for this distant, inaccessible resource rich country. Soviet geologic data for the country are sparse, of questionable quality, and in Russian. The cost of this study to subscribers is \$45,000. If participants were to do this study in house, their cost for the imagery alone would be \$57,600.

A regional geologic study such as the Mongolian study helps to focus the purchaser's attention on the most promising areas. As his focus narrows, exploration costs rise by orders of magnitude. Step 2 in the process is often a high resolution satellite study using TM or SPOT. The total cost of one of these smaller area studies for a single purchaser may be equal to or greater than the regional study; however, the total cost of satellite data and studies represents far less than 1 percent of the drilling exploration cost. Their value is that they have eliminated 90 percent of the study area from further and far more costly consideration. Figure 1 shows a typical regional study. The exhibit provides examples of the products and a world map indicating the location of recent projects.



Location map of the Gobi Foldbelt and Basins, Mongolia.

Northern Arabian Platform, Figure 2 (completed in 9 months on July 15, 1990). The area covered was more than 650,000 square miles. Cost of the study is \$55,000, though recent demand has been low. The imagery, if purchased separately from EarthSat or some other unsubsidized value-added producer, would cost \$84,800.



Location map of the Northern Arabian Platform project area showing Landsat coverage.

Mineral exploration. The minerals industry is a highly sophisticated and discrete user of satellite imagery. Most companies conduct studies in house and do not disclose areas of interest or techniques. EarthSat's support to these companies is in custom image processing which utilizes a variety of proprietary techniques for enhancing surface geological features, lithology and weathering. These techniques proved useful in image processing for the government during the Gulf conflict.

Water exploration. EarthSat is currently involved in water exploration using satellite and other data in southern California. This work is supported by private investors and is for the commercial sale of water. We have also been involved in water exploration for agricultural development in Africa and the Middle East. The well documented use of satellite data in ground water exploration has established this application as one of the most beneficial to society. Unfortunately, it is yet to be widely exploited.

Developing Country Use of Satellite Data

I am including in these remarks observations presented in a Landsat 7 study in which we participated in 1988.² Its relevance is multifold:

- the demand for resource and environmental data in the next two decades will be greatest in the developing world
- the civil sector, commercial and academic, will provide much of the technical assistance required to adequately exploit satellite technology
- global environmental monitoring without local remedial programs is futile—such programs demand high resolution Earth satellite data

²E. Merritt, D. Thibault, "A Study of Landsat 7 Sensor Options and Information Needs of Developing Countries, February 1988.

The exploitation of satellite data by the developing countries requires far more than the timely delivery of the appropriate data to the proper place. (Appendix A contains specific information on the requirements of the developing countries.)

Technical Constraints

(These can be effectively mitigated in many instances between now and 1994 by the effective intervention of data providers, hardware manufacturers, and donors.)

- There is a gap between information needs and data. The technology to enable data purchasers to extract the required information from available data exists in some areas but not in others. The science may exist, but the methodologies for many operational information needs do not exist.
- By the mid-90's, digital satellite data will be the principal product employed in the industrial countries. Image processing and geographic information systems and the ability to effectively employ and maintain these systems must become commonplace in the developing countries if the potential of the data is to be approached.
- The need and perceived need for near real-time access to some satellite data will require the construction of additional earth receiving stations or the expanded use of satellite data relays.
- There are far too few trained scientists, technicians and support personnel in Asia, Africa and Central America to effectively exploit these data. A ten to one hundred-fold increase is required.
- There are too few demonstrations of the use of satellite data for operational programs in the developing world, and few, if any, cost-benefit studies. Without these tools, political leaders and administrators are unlikely to risk employing these technologies.

Economic Constraints

- The developing countries do not have the capital to acquire the tools required to process and analyze satellite data, and these systems will remain a low budget priority until relevant (i.e., local) cost-benefit analyses are available. Donor support is required.
- Ground receiving station construction and operation cannot now be self-amortizing or supporting. Regional cooperation and donor support are required.
- Data are perceived as being too costly, or stated another way, they are undervalued. Cost comparisons to conventional methodologies can help, but unfortunately, at least in the near-term (i.e., the next 20 years), the data are too costly for many applications. Third World countries cannot on their own regularly subscribe to or purchase these data, even though we may demonstrate the value. Donor support and creative pricing may offer solutions.
- The receipt, processing, marketing and distribution of satellite data by foreign earth stations presents a number of problems. Perhaps the most important to the satellite owner/operator is that income from the sale of data must be shared with the station operator; with low access fees (i.e., less than \$2.5 million per year), there is little left to invest in future satellites. Future access agreements must encourage the station operators to dramatically increase marketing and one would expect sales, so that EOSAT's income is significantly increased.

Political Constraints

- In the Third World, only governments are clients for data. The process to establish institutional use of satellite data is a slow one which must compete for scarce funds with programs which daily demonstrate that they are vital to human survival.
- Successful remote sensing programs in the developing world have tended to be in centralized planning, budgetary, or development agencies. Opposition to the gathering of sensitive resource data by these civilian super agencies is often an impediment to the centralization of remote sensing activities.

Positive Forces in the Marketplace

- Resource information needs are real, well recognized, and amenable to remote sensing solutions.
- The technology to meet data needs exists in the suite of sensors EOSAT is considering.
- Operational uses of satellite data for resource development and management exist in the developing world.
- Image analysis and geographic information systems are being purchased by Third World agencies at a steadily increasing rate. These systems require digital data.
- TM and SPOT data have created renewed interest in satellite data and suggested a large market for higher resolution data for mapping and monitoring.
- Donor organizations are showing new interest in these data.

CONCLUSION

Policy Issues: Landsat's 6,7 and Beyond

The following opinions are those of a single commercial value-added user of Earth observation satellite data. EOSAT's Directory of Landsat-Related Products and Services, U.S. Edition³ lists 120 private, public and nonprofit organizations; fewer than 10 of these offer a full range of image processing, analysis and geographic data base building services. EarthSat, founded in 1969, is one of the largest and oldest of these organizations. Our business is worldwide. As mentioned earlier, our clients are primarily commercial organizations, though as with many new-start, high technology businesses, we relied heavily on government research contracts in our formative years. Our opinions are based upon a long and positive experience in the application of remote sensing technologies to a wide variety of natural resource issues.⁴

It is our understanding that among the issues the Congress must address are the following:

1. Should the taxpayers continue to provide financial support, on the order of \$100 million annually, for the Landsat program? Do the public benefits justify the expenditure?
2. What issues would be paramount in the minds of the commercial users of Landsat data should the Federal operational responsibility be changed or the Land Remote Sensing Commercialization Act of 1984 amended?

We recognize that there are many other issues, but we have focused our remarks on the most compelling.

Taxpayer Support

In 1974, EarthSat and Booz-Allen & Hamilton conducted a cost-benefit study of the EATS program for the U.S. Department of the Interior and the Office of Management and Budget.⁵ This was a rigorous economic study. Each ERTS investigation was examined, costs analyzed and benefits calculated. A major assumption was that only continuing applications of the data (i.e., those that required repetitive coverage) qualified for inclusion in the benefits equation. Geologic exploration and periodic mapping (i.e., infrequently updated) were excluded. The conclusion of the study and of several conducted since by EarthSat and others do not show a positive benefit to cost ratio. Obviously, the decision to exclude exploration and some mapping adversely affected the results. The question today is whether the public benefits of Earth sensing technologies are catching up with the costs. They unquestionably are. This is in part a result of the following factors:

- The technology has matured; there are more users; more hardware and software; more trained scientists; and greater institutional acceptance.
- Global and local environmental monitoring require repetitive observations.
- Geographic Information Systems have an insatiable appetite for digital information on the land and seas.

Please note that we are referring to benefits and not to simple cash flow from data sales. It is highly unlikely that the civil sector will purchase enough Landsat 6 or 7 data to cover the cost of operations, marketing and future satellites. Present consumption of 20 percent to 25 percent by the private sector may grow, but without an agricultural or environmental market for repetitive coverage, this percentage will change but slowly. Government is and will continue to be the principal producer, user and beneficiary of Earth satellite data. Use by government should accelerate more rapidly than private sector use because of the demands of environmental monitoring, and the increasing reliance of government on Geographic Information Systems.

Public funding for the Landsat program should be continued for the following reasons:

1. The civil sector is broadly based involving many large and small organizations which could neither individually or collectively support such a program, and private use continues at about 25 percent of the total use. The benefits to the U.S. economy of the commercial activity are substantial. Resource intelligence on remote and inaccessible regions of the world provides U.S. companies a competitive advantage over Japan and Europe. Reliance on Japanese and European remote sensing programs will most assuredly result in a decline in U.S.

³Directory of Landsat Related Products and Services, United States Edition, EOSAT, 1988.

⁴EarthSat, which was founded in 1969, has conducted hundreds of remote sensing surveys, produced more than 20,000 maps, and processed more than 15,000 satellite images from digital satellite data.

⁵Booz-Allen Applied Research Corporation, Earth Satellite Corporation, Earth Resources Survey, Benefit-Cost Study, November 1974.

leadership in remote sensing and related technologies, and the skill essential to deriving the maximum benefit from satellite information. Hardware and software sales are an important component of this economic activity with sales likely exceeding both Landsat data sales and value-added services. These markets will also decline if the U.S. is unable to continue to support the Landsat program.

2. We believe the public sector benefits are compelling. Desert Shield and Desert Storm demonstrated the rapid mapping potential of Landsat and SPOT which complement existing Defense Department programs. Environmental monitoring will require increased reliance on satellite data to observe the health of the planet. Landsat is the cornerstone of the U.S. program and an essential element of any mitigation efforts. Environmental degradation is usually the result of specific human practices which must be located, identified, and observed. Low resolution satellites which may tell us the patient has a fever, are not sufficient for regulation and remediation. In the areas of global and local environmental monitoring, land satellites are essential; without a vigorous and technologically advancing land observation program, the enormous investment in EOS will be wasted.

Issues of Concern to Civilian Landsat Data Users

Recently, there has been much said and written about the future of the Landsat program. Actually, on reflection, it seems that these debates have raged since 1975 and perhaps earlier. Our concerns are several, they are simple, and they have been often voiced by the community of Landsat data users—public, private and academic. Here, I will claim to represent the vast majority of data users. These principals are embodied in the Land Remote Sensing Commercialization Act of 1984:

- Open skies as provided in the Act.
- Nondiscriminatory access to data—Non-discriminatory access must apply to both price and system availability (i.e., one user must not be allowed to command full system capability to the exclusion of other users except for national security reasons).
- Continuity—Here perhaps we speak for ourselves. We favor general continuity but not a one-for-one copy of the existing system. Spectral bands may be changed so long as the general spectral regions covered by Landsat 6 are included. Slight changes and even elimination of some bands are acceptable if the users have an opportunity to comment and the decisions represent a consensus of the users. It is convenient to have similar coverage patterns from one satellite to the next, but not essential. Today's computers allow us to combine disparate data sets. When continuity and technological advancement conflict, we favor progress. If funding realities mandate that Landsat 7 be a clone of Landsat 6, we will be terribly disappointed, but we view program continuation without interruption as essential to the commercial market.
- Service—Regardless of the application, customers' needs must be met quickly, efficiently and consistently. Without service, there can be no growth.
- Technological progress—In many respects, Earth sensing from space is an infant technology with seemingly infinite potential. Airborne studies have shown that increased spectral resolution will contribute significantly to environmental monitoring, geological exploration, and military intelligence. Increased spatial resolution will obviously contribute to mapping, as will stereo coverage. However, it is not sufficient to fund the development of new sensors and spacecraft. Without research funding, more and different will not provide better solutions. New generations of specialized processing hardware and software will be required in our universities and research organizations or the data will be under-exploited. Industry is prepared to share in the cost of this research, but the principal burden will again fall upon government, the principal beneficiary of these programs.

E. Merritt, D. Thibault. A Study of Landsat 7 Sensor Options and Information Needs of Developing Countries. 1988. Earth Observation Satellite Company.

W. Brooner, P. Maughan, D. Thibault. An Assessment of Information Demands for Remote Sensing and Geographic Information Systems Technologies. 1988. U.S. Agency for International Development.

International Society for Photogrammetry and Remote Sensing. report of The Committee for "Acquisition and Processing of Space Data for Mapping Purposes." 1984.

Senator GORE. Thank you very much. May I comment on your last remark? We will have a hearing in the Armed Services Com-

mittee on Thursday exploring this initiative to which you referred for the last—well, 3 years ago I initiated discussions with the intelligence community about how these data bases now in the black could be made accessible without compromising national security data to environmental and earth science researchers.

That dialog has now gathered speed. I have had a number of meetings with Mr. Gates at the CIA and others within the intelligence community. I might say for the record that I have been extremely impressed with the response of the CIA and Mr. Gates in particular to this initiative and I appreciate the private sector participants as well.

The top priority is to ensure the national security aspects of any data involved. That cannot be compromised in any way, but the good news is we are finding imaginative ways to make that data accessible to researchers. I quite agree with your last comment that certainly the integrated program which results should see the Landsat data made a part of that data base.

We are going to hold questions as customary until the full panel has concluded. Our next witness is Dr. Brent Blackwelder, a long-time friend and schoolmate in fact, and Vice President for Policy with Friends of the Earth. Welcome, Dr. Blackwelder.

STATEMENT OF DR. BRENT BLACKWELDER, VICE PRESIDENT FOR POLICY, FRIENDS OF THE EARTH

Dr. BLACKWELDER. Thank you, Mr. Chairman. We appreciate the opportunity to be here and thank you for holding this hearing and for your leadership on important environmental issues.

Friends of the Earth is a national environmental organization. We have affiliate member groups in 47 countries around the world. The basic thrust of our message today is that better information is going to lead to better decisions, but that under the current situation we are going in exactly the opposite direction.

I would like to introduce for the record a letter to Senator Gore which is signed by a large number of environmental organizations, major national farm organizations, the National Congress of American Indians, the American Library Association, the American Forestry Association, the National Association of Counties, the National Association of State and University Land Grant Colleges. All of these organizations are firmly wedded to the view that we have to do something different to get out of the status quo. They are all in support, Senator Pressler, of your legislation and its basic thrust, and we suggest in this letter a number of ways in which that legislation could be strengthened and sharpened, and in particular given some special emphasis on public education and the use of this material in the public schools.

Let me reiterate one of the comments which you, Senator Pressler, made earlier about Halbouty Advisory Committee, because we had a caution of the pending disastrous situation back in 1982, when that advisory committee wrote, "a designation of a sole operator which would have exclusive and proprietary rights to the data from acquisition to delivery to users under conditions of guaranteed subsidy and guaranteed tax incentives would severely limit the degree of natural market development."

The report insisted that a full archive of Landsat data be established in the public domain and maintained, that the real potential for commercialization lies not in the sale of raw data but value-added services and development of software programs to make data interpretation accessible to potential users.

So, we had that warning. It was not followed, and now we have seen the precipitous decline. I do not know if other panel members will be introducing some of the graphs showing the decline—the precipitous decline in the requests for Landsat data, but if they do not, I would like to introduce some of these graphs for the hearing record, and they all show just a dramatic dropoff in people, Government, and individuals using Landsat data, exactly the opposite of what we thought and had hoped would be occurring.

Senator PRESSLER. How dramatic is that dropoff? Well, I should be saving this until questions, but could you give us one example?

Dr. BLACKWELDER. Yes. I will just give you an example of Landsat purchases by academia. You had in, say, take a year—1982—about 8,000, and it has dropped down to well under 1,000, and in fact some data acquisition has dropped down from in the tens of thousands, over 10,000, to just 5,000, say, in the year 1990, so it is fairly astonishing, that would be the only term to apply to it, and the data being used by environmental and conservation organizations is at a low ebb.

Dr. Robert Jenkins, who is vice president for science at the Nature Conservancy, which manages over 20 million acres of critical habitat in the Western Hemisphere, has advised us that the Conservancy would use from 10 to 100 times as much Landsat imagery as it presently uses if the pricing were different, if it could be obtained at a reasonable price.

I wanted to correct a misimpression, perhaps given from the earlier panel members. The use of data by environmental organizations and other nonprofit groups is not local or regional, necessarily. Some of it is, some of it is national and some of it is international, and so we are using data at all those levels, not exclusively one or the other.

Finally, let me turn to just a couple of points. The administration may argue that funds are unavailable to carry out major reforms which could involve possibly a buy-out of EOSAT, but we urge the committee to look very closely at this possibility. It may not be as expensive as some might suggest, and in another situation we want to comment about the relationship of reform here to the notion of jobs. Often it has been portrayed that environmentally beneficial choices cost jobs. In our view, that is 180 degrees opposite from the truth. The positive environmental positions always, in our judgment—and the evidence supports this—create many more jobs and so if you go and produce this reform we think that the utilization of data will be tremendously beneficial for the environment and will lead to a great many more jobs throughout the country.

Finally, I want to comment on the OMB publication which appeared in the Federal Register at the end of April. While the proposal is sound to move toward a marginal cost pricing and availability of data there is no guarantee that this actually will become a final regulation and that it will be enacted. The comments, after all, are not due to be completed until August 27. Things could lan-

guish. There is no substitute for decisive action by this committee now.

Senator PRESSLER. Thank you. Next, I will call on Dr. John R. Jensen.

STATEMENT OF DR. JOHN R. JENSEN, CAROLINA RESEARCH PROFESSOR, DEPARTMENT OF GEOGRAPHY, UNIVERSITY OF SOUTH CAROLINA

Dr. JENSEN. Thank you very much. It is an honor to testify on the Land Remote Sensing Policy Act of 1992. I strongly endorse the legislation. I will identify specific reasons why I endorse the decommercialization of the Landsat program and make specific recommendations.

Senator Pressler, in his address of February 27, said the goal of S. 2297 was to maintain its leadership in land remote sensing by providing data continuity for the Landsat program. I totally agree.

The remote sensing scientists in the United States are the recognized leaders in the world today in understanding how to capture, analyze, and model land remote sensing data. Unfortunately, the current Landsat 4 and 5, and the proposed Landsat 6 in 1993, are antiquated. Therefore, I believe the United States is no longer the leader in satellite remote sensing technology. Commercialization of the Landsat program has brought the United States to this point.

I am not the only academic who believes this. A recent study by Estes and Jones in 1992—299 questionnaires sent out, 167 received. When asked the question, has commercialization of remote sensor data had a positive or negative impact on remote sensing research, 77 percent viewed it as negative or very negative. When asked, has commercialization of remote sensor data had a positive or negative impact on remote sensing education in the United States, 74 percent said negative or very negative. When asked, how strongly would you support the Federal Government taking over the operation of the Landsat system, an overwhelming 86 percent registered either support or strong support. Only 4 percent were opposed. Therefore, there is a tremendous groundswell of support among some academics in the United States for Government decommercialization of the Landsat program.

I believe this groundswell of support for decommercialization is due to two factors. One is the almost obsolete sensor systems, and two is the pricing and data availability problem. I will address aspects of these two concerns.

Landsat 4 and 5 were magnificent sensor systems when they were put up in 1982 and 1984. Unfortunately, the United States gave up its lead in satellite remote sensing when the French launched the SPOT satellites in 1986 and 1990. You have no idea how frustrating it is working with local and State agencies, and also nonprofit organizations doing remote sensing when we constantly have to buy foreign data to satisfy our needs. This happens around the United States every day of the year, from the local to the State level. Approximately 80 percent of the data now purchased in South Carolina for our needs is usually SPOT data.

Let me address some of the hardware and technical issues. First of all, Landsat 4, 5, and even 6 coming up, are based on old scanning technology. Conversely, SPOT is based on linear charged cou-

pled device technology that can simultaneously image an entire line of data in the cross-track axis without mechanical movement. This assures high geometric accuracy, and our sensors should have this capability. We also have a lot of stripping in our data. We all too often spend a lot of time removing it.

The spectral resolution I am going to dwell on just for a second. This new band—the panchromatic band—is touted a lot as being a tremendous new improvement. This band is not at all like the SPOT panchromatic band, which is .5 to .7 μ m. The TM panchromatic band is .5 to .9 μ m. People I ask do not know anything about this band.

If you look at Figure 4, you will see that the two band widths are totally different. One spans green, red, near-infrared—the new Landsat system. And SPOT spans .5 to .7. We have 40 to 50 years of experience with the SPOT-type panchromatic band because it is based on aerial photography. Not so with the new Landsat 6, but it is cast in stone. It is going to happen. No one knows the scientific utility of it. When used for classification or other purposes, it may be of use, we just do not know.

Where were the symposia? Where were the test data sets? Where was the interaction with the user community out there down at the State and local level to select this band?

Also, Landsat 6 has a spectral problem. While they tout the fact that Landsat 6 will have a new panchromatic band, it can only be acquired at the expense of valuable information in other bands. The data stream is going to be reduced to only three configurations according to promotional literature.

You can obtain the original seven TM bands—no big improvement there. You can obtain data from the panchromatic band and bands 4, 5 and 6, or panchromatic and bands 4, 6, and 7. So, what used to be the saving grace for Landsat, having high spectral resolution, is now going to be degraded. It is no longer a vast improvement when you cannot even get a blue band and a panchromatic band in the same data stream.

SPOT provides the whole data stream. Our Landsat system will not. I hope that the thinking behind this has not been a function of doing more global research to cut down the data stream, which is what I heard today. That will severely impact the local users, which is where the taxpayers are in the United States. The States have to do the research, and the sensor systems are not there to provide the data.

Also, SPOT provides across-track stereoscopic coverage. This is a very powerful, very important new technology. It generates orthophoto 10-meter data, and also stereoscopic data which can be used to create digital elevation models, which are the heart of geographic information systems at the local and regional level. Our new systems have nothing like this, and I hope that Landsat 7 will.

I am going to skip now a few pages and just go to some of my final recommendations about the sensor system. Even with Landsat 6 launched in January 1993, we will continue to have substandard temporal resolution—that is, there is no “pointability” capability like on SPOT. Pointability is very powerful, especially in South Carolina, to get cloud-free imagery. Also, we will have substandard spatial. We are going to have 30- and 15-meter spatial

resolution on Landsat 6. Well, the SPOT system was 20 and 10 meters in 1986. Certainly we could have done better by 1993.

The utility of the Landsat 6 panchromatic spectral resolution may not prove as useful as expected because it is an untested band width, as far as I am concerned anyway, and the limited data streams available to the user community. Conversations with SPOT suggest that SPOT 4 will have a 10-by-10 meter panchromatic, a new midinfrared band copying the Landsat system, 4 or 5 new bands at 1-by-1 kilometer resolution to get into the global change business, and this will be in 1996. So, we are going to be catching up with SPOT, it looks like, forever.

The president of SPOT Image, Nanz, says that they plan, "to go to 5-meter resolution when it launches its privately funded satellite at the turn of the century." Thus, it is critical that the United States begin now to make Landsat 7 as good as possible, if we are to regain our U.S. leadership in land remote sensing.

What really scares me is when people talk about Landsat 7 being a clone of 6, and I heard it again today. I like the idea of improved sensor systems. In fact, I totally endorse them, and I have provided in table 2 a suggestion as to what Landsat 7 should be. It is based on the work at U.S. Geological Survey by Light in 1990 and Colvocoresses in 1991.

Perhaps one more minute to sum up my feelings about cost. I am not going to get into the value-added issue. The current price of Landsat MSS is \$1,000 for a MSS scene, \$4,400 for a single Landsat TM scene. This is outrageous. It is the price of a small car. Foreign countries also have similar price concerns. I have listed the U.N. findings on page 7.

I also recommend that under the direction of NASA and DOD, the price of future Landsat data recover the cost of duplication only. I recommend this pricing policy be for everyone—scientists, educators, public institutions, and private industry. This would eliminate the policing which must accompany a multiple tier pricing structure.

Finally, we should never have data acquisition fees and cloud cover service charges, as we have had in the past. We have to be able to share the data. This cuts down on making multiple copies and the costs associated with that. I recommend that public universities, State agencies, and other nonprofit groups be allowed to buy a single copy of the raw, unenhanced data and then share it freely. Unenhanced Landsat data purchased by private companies for value-added profit taking should not be sharable. Also, the data should be available within 14 days of data acquisition.

Finally, a significant attempt should be made to obtain the worldwide Landsat global change basic data set as soon as possible. I suggest following the techniques described by Colvocoresses in a 1991 article in *Photogrammetric Engineering and Remote Sensing*.

My final statement is a suggestion of what we need in the State of South Carolina to do our day-to-day monitoring of environmental resources. Our State is very typical. A new, improved Landsat 7 would allow us to do the work with U.S. data. South Carolina desires to purchase remotely sensed data from the United States and not from a foreign country or a private industry which charges exorbitant prices.

Thank you very much.

[The prepared statement of Dr. Jensen follows:]

PREPARED STATEMENT OF JOHN R. JENSEN

I. INTRODUCTION

Thank you for the opportunity to testify on S. 2297, the Land Remote Sensing Policy Act of 1992 and other issues related to land remote sensing.

I strongly endorse the proposed Land Remote Sensing Policy Act of 1992 as summarized in S. 2297. The proposed legislation should allow the United States to recapture its lead in land remote sensing. I will identify very specific reasons why I endorse the "de-commercialization" of the Landsat program and make specific recommendations to the committee which I hope can be considered.

II. The United States Has Lost Its Technological Leadership in Land Remote Sensing Sensor Systems

In the opening remarks to Congress on February 27th, 1992, Mr. Pressler stated that the goal of Senate bill 2297 was to

"* * * maintain its leadership in land remote sensing by providing data continuity for the Landsat Program * * *"

I agree that remote sensing scientists in the United States are the recognized leaders in the world today in understanding how to capture, analyze and model land remote sensing data using analog and digital image processing techniques to provide valuable environmental information. Unfortunately, the current (Landsat 4 & 5) and proposed (Landsat 6) sensor systems deployed are antiquated. Therefore, I believe the United States is no longer the leader in satellite land remote sensor technology. Commercialization of the Landsat system has brought the United States to this point.

I am not the only academic who feels this way. For example, Estes and Jones (1992) recently conducted an in-depth survey of academic geographers in the United States on their feelings about Landsat commercialization (academic geographers conduct the majority of the remote sensing teaching in the U.S. and a substantial amount of the research). Out of 299 questionnaires sent, 167 were returned. When asked "has commercialization of remote sensor data had a positive or negative impact on remote sensing research?", 77 percent felt it was negative or very negative (Figure 1). When asked "has commercialization of remote sensor data had a positive or negative impact on remote sensing education?", 74 percent said negative or very negative (Figure 2). Finally, when asked "how strongly would you support the federal government taking over the operation of the Landsat system?", an overwhelming 86 percent registered either support or strong support, while only 4 percent were opposed (Figure 3). Thus, there is a tremendous groundswell of support among our academics for federal government de-commercialization of the Landsat program.

Landsat 4 & 5 and Even Landsat 6(1993) Sensor Systems are Almost Obsolete

Landsat 4 with its Thematic Mapper (TM) and Multispectral Scanner (MSS) sensor systems was launched on July 16, 1982 and Landsat 5 on March 1, 1984. They were magnificent sensor systems for their time, representing the best land remote sensing systems in the world in terms of spatial, spectral, temporal, and radiometric resolution (Table 1). They were placed in orbit while the United States government was in charge of the land remote sensing program. EOSAT signed the contract to begin commercialization in September, 1985. At that time it was hoped that EOSAT in conjunction with the federal government would devote considerable resources to the continued development of improved Landsat remote sensor technology. Unfortunately, under commercialization from 1985 to May 6, 1992, we have not seen any improvement in the spatial, spectral, and temporal characteristics of the Landsat system. Even when Landsat 6 is launched in January, 1993 we will see only modest improvement which will still be based on antiquated "scanning mirror" technology.

Basically, the United States gave up its lead in satellite remote sensing when the French launched the Le Systeme Pour l'Observation de la Terre (SPOT) on February 21, 1986 (and SPOT 2 in 1990). It is instructive to review the characteristics of the Landsat Thematic Mapper we currently have and compare it to what the French SPOT satellites provide (Tables 1 and 3). It is also useful to identify the proposed Landsat 6 and SPOT 4 sensor systems (Tables 1 and 3) to determine if the United States can regain its leadership in land satellite remote sensor technology. Finally, an opinion about the optimum Landsat 7 sensor system configuration is provided (Table 2).

Remote Sensor Detector Hardware

Landsat: Landsat 4 (1982), Landsat 5 (1984), and even Landsat 6 (1993) are based on "scanning mirror" technology (Jensen, 1986; Fischal, 1992). The moving mirror in a mechanical scanning sensor is subject to wear, has variable speed of movement across the image causing across-track geometric distortion, and contributes to instability of satellite orientation (Campbell, 1987). Furthermore, the scanner technology often yields substantial "stripping" which is especially troublesome when performing water quality research (Jensen et al., 1989).

SPOT: Conversely, the French SPOT High Resolution Visible (HRV) sensors use "pushbroom" scanning technology based on charge coupled devices (CCDs) that can simultaneously image an entire line of data (in the cross-track axis) without mechanical movement. SPOT linear arrays consist of some 6,000 detectors for each scan line in the focal plane; the array is scanned electronically to record brightness values in each line. The absence of moving parts provides greater reliability, more uniform scanning speed across the image swath, and greater stability of the satellite, thereby assuring higher geometric accuracy (Campbell, 1987). Future Landsat sensor systems should be based on this type of linear or area array technology.

Spectral Resolution

Landsat: From 1982 until the launch of SPOT 1 on February 1, 1986, Landsat 4 & 5 TM sensor systems had the best spectral resolution in the world (Table 1; Figure 4). The three visible, near-infrared, and two mid-infrared bands have been of significant value to a tremendous variety of environmental problems. The thermal infrared band has only been of marginal value, due primarily to its poor spatial resolution (120 x 120 m) and often excessive stripping. These same bands plus a panchromatic band from .5 - .9 μ m will be used on Landsat 6 in 1993. Unfortunately, the bandwidth of the new Landsat 6 panchromatic band was not selected by rigorous scientific experimentation. Its selection was based on an in-house simulation study (Fischal, 1992) using an aircraft mounted ITRES sensor system acquiring data at 7.5 x 7.5 m spatial resolution (later resampled to 15 x 15 m pixels). No one knows the scientific utility of the new TN panchromatic band compared to the proven success of the SPOT panchromatic band (.51-.73 μ m) which was selected based on 40 years of applications using panchromatic aerial photography in the same spectral region. They bypassed the scientific/academic community in the selection of what appears to be the most important new component of the Landsat 6 system.

Landsat 6 has another significant "spectral" problem. While they tout the fact that Landsat 6 will have a new panchromatic band, it can only be acquired at the expense of valuable information in other bands. In fact, the user community only has three data acquisition choices: a) obtain data using the original 7 TM bands (no new improvement of technology here), b) obtain data from the panchromatic band, band 4, band 5, and band 6, or c) panchromatic, band 4, band 6, and band 7. Thus, there is no way to get the original 7 TM bands plus a panchromatic band! While users of SPOT panchromatic and multispectral (XS) data are allowed to purchase the entire data stream, users of Landsat 6 data must purchase two complete data streams (if possible) to obtain the bands they will need for most applications. This is totally unsatisfactory for state remote sensing applications as has been summarized in a letter from South Carolina state agencies (Sommers, 1992).

Fischal (1992) states that these limited data streams are the result of being constrained to ≤ 85 Mbits/second to minimize the impact on foreign ground receiving stations. Why wasn't the United States user community consulted on what might have been deleted, such as the seldom used thermal channel or perhaps one of the mid-infrared bands? Instead, the "new technology" of Landsat 6 cannot even be used to create standard natural color or color-infrared composites which are so helpful in most research endeavors (Chavez et al., 1990) without purchasing two complete data sets (if possible). Furthermore, it is widely known that when remote sensing vegetation (agriculture, forestry, wetlands), it is best to include a band from the visible, the near infrared, and the mid-infrared in addition to the panchromatic data (e.g. bands 3, 4, 5, and pan; Jensen et al., 1990). This most important data stream is not even an option under the proposed Landsat 6 system! This is another example of not consulting closely with the United States remote sensing scientific community before making decisions.

SPOT: The SPOT 1, 2, and 3 (1994) HRV instruments record energy in green, red, near-infrared and panchromatic wavelengths (Table 3). Users of SPOT panchromatic and multispectral (XS) data are allowed to purchase the entire data stream, not just subsets of it. The lack of mid- and thermal infrared bands has not stifled the purchase of SPOT scenes as most environmental remote sensing applications can be adequately performed using these four bands. Furthermore, the SPOT system can acquire across-track stereoscopic coverage which is so important for the creation of

small scale planimetric maps and digital elevation models. Much of the digital image processing industry in the United States (ERDAS, Intergraph, R-Wel, 125 etc.) recently developed "soft-copy photogrammetry" software to derive digital elevation models from such data which often represent the heart of local and regional geographic information systems.

SPOT 3 (identical to SPOT 1 & 2) is built and ready to be launched. SPOT 4 is being constructed and is tentatively scheduled to provide a new mid-infrared band plus 4 to 5 new, yet-to-be-determined bands designed to collect 1 km x 1 km vegetation information (Figure 3). This "veg" information will be obtained over the entire earth once per day if desired. Thus, SPOT Inc. is actively moving into the global vegetation monitoring marketplace with this new sensor system, while continuing to improve its high spatial Landsat TM scene (60 x 60 km versus 185 x 170 km, respectively). This can be a problem when studying extremely large areas.

Spatial Resolution

Landsat: Landsat 4 & 5 TM data from 1982 to 1986 were the best in the world with 30 x 30 m spatial resolution for all bands except the thermal channel (120 x 120 m). Landsat 6 (1993) will have exactly the same bands and spatial resolution as Landsat 4 & 5 except for a new 15 x 15 m panchromatic band. Unfortunately, this 15 x 15 m panchromatic capability will still not be as good as the SPOT 10 x 10 m panchromatic data available since 1986.

SPOT: Since 1986, SPOT 1 & 2 HRV sensors have recorded multispectral imagery at 20 x 20 m spatial resolution and panchromatic data at 10 x 10 m. These spatial resolutions revolutionized land remote sensing from space because a) many studies of heterogeneous vegetation (e.g. wetland, forests, rangeland) require higher 20 x 20 m spatial resolution multispectral data, and b) many urban and suburban applications can be performed with panchromatic 10 x 10 m spatial resolution data. There has been a tremendous demand for the use of the panchromatic 10 x 10 m data where the rectified image data are used as a background layer in geographic information systems (GIS). SPOT 5 is to have 5 x 5 m panchromatic data capability, which will make Landsat 6 even more obsolete.

Temporal Resolution

Landsat: Landsats 4 & 5 have a repeat cycle of 8 to 16 days if both sensors are functioning. Landsat 6 will also be "non-pointable". This fixed temporal resolution means that Landsat data will always be difficult to acquire over relatively cloudy regions and that special off nadir emergency acquisitions (e.g. Chernobyl, the Persian Gulf War) may not be acquired.

SPOT: From the beginning, the SPOT HRV sensors could be pointed off-nadir (the point directly below the spacecraft) to acquire data. Using the off-nadir viewing capability, SPOT can acquire repeat coverage at intervals of 1 to 5 days, depending upon latitude (Campbell, 1987). This results in significantly greater number of data acquisitions to be made of areas of interest when the sensors are not directly overhead. It is especially useful for obtaining imagery over areas with cloud cover problems. Furthermore, when an accident like Chernobyl or the Persian Gulf oil spill occurs, the SPOT system can be pointed to obtain data relatively quickly.

The United States land remote sensing system must become a "pointable" sensor system.

Radiometric Resolution

The radiometric sensitivity of current and proposed Landsat TM data and SPOT data are sufficient for most earth resource applications. The data are quantized to 8 bits and provided on a variety of media (6250 bpi tapes, 8mm, and floppy disks).

Recommendations for a Landsat 7 Sensor

Even when Landsat 6 is launched in January 1993, we will continue to have sub-standard temporal (i.e. no pointability) and spatial resolution (i.e. only 15 x 15 m panchromatic and 30 x 30 m multispectral versus SPOT 10 x 10 panchromatic and 20 x 20 m multispectral data). Furthermore, the utility of the Landsat 6 panchromatic spectral band may not prove as useful as expected because of a) its untested bandwidth, and b) the limited data streams available to the user community.

I serve on the SPOT "Academic Advisory Committee." I have also provided SPOT with my opinion on future SPOT sensor systems. Conversations with Clarke Nelson at SPOT suggest that SPOT 4 (tentatively scheduled to be launched in 1996) is expected to have a) a 10 x 10 m panchromatic band registered to the multispectral data, b) a mid-infrared band, and c) four or five new bands at 1 km by 1 km spatial resolution which will inventory the earth once every day for global science applications (Table 3). The President of SPOT Image Inc., Theodore Nanz says SPOT 5

“* * * plans to go to five-meter resolution when it launches its privately funded satellite at the turn of the century” (Stephens, 1991; Table 4). Thus, it is critical that the United States begin now to make Landsat 7 as good as possible if we are to regain our U.S. leadership in land remote sensing systems. What really scares me is when people talk about making Landsat 7 a clone of Landsat 6. For example, “Silvestrini said a Landsat 6 clone would only cost about \$250 million.” (EOSAT, 1991). Therefore, a National Landsat Advisory Council should be established to a) receive input from university, public, and private industry remote sensing scientists, and b) direct new sensor system development. If this is not done, it appears we will fall further behind in land remote sensor technology.

I suggest that the sensor system summarized in Table 2 be considered for Landsat 7. This is based on years of personal experience with Landsat MSS and TM data, SPOT XS and panchromatic data, aircraft multispectral scanning systems (e.g. Daedalus) and the conceptual sensor system design put forth by Light (1990) and Colvocoresses (1991). First, multispectral data should be acquired in the bands shown at 10 x 10 m spatial resolution. A panchromatic band from .51-.73 μm should collect data at 5 x 5 m spatial resolution. All of the data stream should be available to the user community. This would satisfy 90 percent of the earth resource applications. To satisfy planimetric and topographic mapping activities at 1:50,000 scale, a fore and aft panchromatic stereoscopic viewing capability is required which will yield 10 m contour intervals which meet national map accuracy standards. These data should be acquired using linear and/or area array remote sensor technology, not scanner technology. All sensors should be pointable, if possible. It is recognized that such a system will generate a significant data stream (266 Mbits/second) but that it “is within the limits of current technology” (Light, 1990). This type of remote sensing system should be deployed if the United States is serious about regaining its leadership in satellite land remote sensor technology.

III. LANDSAT DATA ARE TOO COSTLY, CANNOT BE SHARED, AND ARE NOT PROVIDED IN A TIMELY MANNER

The Prohibitive Cost of the Landsat Data

The Landsat system has been managed by a) the EROS Data Center, b) NOAA, and c) EOSAT. The current price of Landsat MSS data are \$1,000 per MSS scene (for those ≤ 2 years old) and \$4,400 for a single Landsat TM scene (system corrected; October 1, 1991). This is outrageous. The exorbitant escalation in cost of both the photographic and digital products has resulted in a tremendous decrease in total items purchased [Figure 5; from Silvestrini (1991) and EROS Data Center (1991)]. The pricing structure has hindered the effective use of satellite data in the U.S. and the world for ecological applications (Roughgarden, et al. 1991) and is partially to blame for the feelings of many U.S. academics toward commercialization as summarized in Figures 1-3.

Foreign countries also have similar concerns (Voute, 1987; Lauer et al., 1991). For example, in the opening session of the meeting of Directors of National Remote Sensing Centers, sponsored by the United Nations Development Program's Economic and Social Commission for Asia and the Pacific (ESCAP), in Shanghai, People's Republic of China, in July, 1988, the Executive Secretary of ESCAP commented on the “* * * widespread concern about the increasing cost of obtaining remotely sensed data,” and the need to “* * * explore the possibility of assisting member countries to obtain such data at more reasonable prices” (Kabria, 1988). Then, one director after another included a statement in his or her annual report that condemned current pricing policies for Landsat and SPOT data. For Indonesia, it was “* * * the unfavorable price relating to satellite imagery” (Irsyam, 1988); for Pakistan, “* * * the commercialization of satellite remote sensing systems and the increasing cost of space segment services could have an adverse effect on the development of remote sensing programs” (Mehmud and Mirza, 1988); and from Sri Lanka, “paucity of funds has also limited the frequency with which air photography or satellite imagery could be obtained” (Berugoda, 1988). Even a recent report from the People's Republic of China noted that, if the costs of satellite imagery continue to remain high, China and other countries in the region may have to abandon satellite remote sensing technology and return to the sole use of aerial photography (He, 1989).

It is recommended that under the direction of NASA/DOD, the price of future Landsat data recover the cost of duplication only. I hope this would be $\leq \$300$ for digital MSS data and $\leq \$500$ for digital TM data. The Landsat sensors were created, placed in orbit, and operated at considerable public expense. The public should not be charged an exorbitant fee for their own data. I recommend this pricing policy be for everyone: scientists, educators, public institutions, and private industry. This

would eliminate the "policing" which must accompany a multiple-tier pricing structure.

EOSAT has charged per scene "data acquisition fees" and also levied a "cloud cover service charge" for certain orders. All Landsat "data acquisition fees" and "cloud cover service charges" must be eliminated. It appears that these changes in policy may become effective for the Landsat 6 processing era. Why did it take until 1993 to implement them? Common sense would suggest that these fees in addition to the extremely high cost of the raw data would keep many people from purchasing Landsat products.

I believe that if these price policies were instituted, the number of digital scenes purchased for land remote sensing research in the U.S. and abroad would be astounding.

The Prohibitive Sharing Policy

For years, the Landsat Data Use Agreement has strangled remote sensing research at public universities and in state agencies. I recommend that public universities, state agencies, and other non-profit groups be allowed to buy a single copy of the raw, unenhanced remote sensor data and then share it freely among academic departments (e.g. geography, marine science, agriculture) or public agencies (e.g. Water Resources, Land Resources, Fish and Wildlife, Coastal Council etc.). It took EOSAT seven (7) years to learn this valuable lesson. Only in 1991 did EOSAT initiate a statewide data acquisition program (Burroughs, 1992). This type of thinking should be encouraged and continued. Unenhanced Landsat data purchased by private companies for value-added profit taking should not be "shared."

The Timeliness of Data Delivery

Through the years, the EROS Data Center, NOAA, and finally EOSAT have had a notoriously bad reputation for remote sensor data delivery, although EOSAT has improved their performance during 1991-1992. I recommend that if a purchase order is in place, the data should be delivered to the user within 14 working days. Furthermore, I suggest that the transmission of the data over Ethernet lines from NASA/DOD to the user be investigated immediately. In many instances, this procedure would remove the hard copy handling and shipping, reduce cost, and speed up delivery. This is possible using 1992 technology, especially during late night hours.

IV. LANDSAT DATA MUST BE ACQUIRED AND ARCHIVED TO SUPPLEMENT THE GLOBAL CHANGE DATA OBTAINED BY THE EARTH OBSERVING SYSTEM (EOS)

There is great interest in the Earth Observing System (EOS) sensors which will begin to be placed in orbit sometime in 1998 (Wickland, 1991). These sensors were designed with a great deal of thought and will provide a significant amount of information to model and monitor worldwide global change. It is anticipated that the Landsat archives which already contain a unique set of data stretching back 20 years will be heavily used to a) represent the only true longitudinal land use/land cover data base for the cloud-free portions of the earth, and b) calibrate the new sensors that will fly as part of EOS. There are still major gaps in the "basic data set" because Landsats 4 and 5 are only turned on selectively due to TDRSS link problems and there is the desire to conserve the sensors so that we don't have a "data gap" before Landsat 6 is launched (Silvestrini, 1991; Harper, 1992). Nevertheless, a significant attempt should be made to obtain the worldwide Landsat global change "basic data set" as soon as possible as suggested by Colvocoresses (1991).

V. WHILE THE EARTH OBSERVING SYSTEM (EOS) WILL BE OF VALUE TO ADDRESS GLOBAL CHANGE PROBLEMS, THE LOCAL, COUNTY, STATE AND FEDERAL AGENCIES MUST RELY ON A QUALITY LAND REMOTE SENSING SYSTEM TO MEET THEIR DAY-TO-DAY ENVIRONMENTAL MONITORING REQUIREMENTS: THE SOUTH CAROLINA EXAMPLE

The proposed EOS sensor systems, however, will probably have very little impact on the day-to-day data requirements of local, county, state, and even federal land remote sensing programs. While several EOS sensors record high spectral resolution information, most of them (except ASTER) acquire data with a spatial resolution more coarse than 30 x 30 m (Wickland, 1991). Thus, to perform the day to day monitoring of the natural resources in our individual states, we must have a reliable earth resource remote sensing system providing high spectral and spatial remote sensor data at reasonable cost and in a timely fashion. Below is an abbreviated summary of the type of land remote sensor data required by the State of South Carolina to monitor its resources into the 21st Century. We would hope the Land Remote Sensing Policy Act of 1992 would articulate the creation of a United States program which will provide such remote sensor data.

The State of South Carolina's Remote Sensing Requirements

1) *Made in the U.S.A.*: South Carolina desires to purchase remotely sensed data from the United States and not from a foreign country or private industry which charges exorbitant prices.

2) *Sensor System Requirements*: Ninety-five percent of South Carolina's land remote sensing data requirements could be fulfilled by a system which collects 5 x 5 m panchromatic and 10 x 10 m multispectral data in standard TM bandwidths. Ideally, the sensor would be pointable allowing more frequent data acquisition which is a serious problem during South Carolina's cloudy growing season.

3) *Cost*: The remotely sensed data should be made available for the cost of data reproduction. No "data acquisition" fee or "cloud cover service charge" should be applied.

4) *Data availability*: South Carolina must have the ability to purchase a single copy of an image and share it among all state universities and agencies. The data should be delivered within 14 days from date of acquisition.

Thank you for the opportunity to present my views on the Land Remote Sensing Policy Act of 1992.

Table 1.—Landsat Thematic Mapper 4 (1982), 5 (1984), and 6 (1993) Sensor System Configurations

(Source: Jensen, 1986; EOSAT, 1992)

Sensor	Spectral	Spatial ³	Temporal	Quantization
Blue ¹	0.45–0.52 μ m	30 x 30 m	16 days	8 bits.
Green ¹	0.52–0.60 μ m	30 x 30 m	16 days	8 bits.
Red ¹	0.63–0.69 μ m	30 x 30 m	16 days	8 bits.
Near-IR ¹	0.76–0.90 μ m	30 x 30 m	16 days	8 bits.
Mid-IR ¹	1.55–1.75 μ m	30 x 30 m	16 days	8 bits.
Thermal ¹	10.4–12.5 μ m	120 x 120 m	16 days	8 bits.
Mid-IR ¹	2.08–2.35 μ m	30 x 30 m	16 days	8 bits.
Pan ²	0.50–0.90 μ m	15 x 15 m	16 days	8 bits.

¹These bands are found on Landsat TM 4, 5, and 6 (1983).

²This band will be found on Landsat 6 (1993).

³185 km swath width.

Table 2.—Proposed Future Landsat Sensor System (7 or 8) for Earth Science and Cartographic Mapping Applications at 1:50,000 Scale and Smaller To Regain U.S. Lead in Land Remote Sensing Technology (Tentatively Launched in 2000)

(Source: Light, (1990); Colvocoresses, (1991) Author)

Sensor	Spectral	Spatial ²	Temporal	Quantization
Blue-green ¹	0.47–0.57 μ m	10 x 10 m	45 days or pointable	8 bits.
Red ¹	0.57–0.69 μ m	10 x 10 m	45 days or pointable	8 bits.
Near-IR ¹	0.76–1.05 μ m	10 x 10 m	45 days or pointable	8 bits.
Mid-IR ¹	1.55–1.75 μ m	10 x 10 m	45 days or pointable	8 bits.
Pan ¹	0.51–0.73 μ m	5 x 5 m	45 days or pointable	8 bits.

¹Linear Array push-broom, each band.

²64 km swath width.

Table 3.—SPOT 1, 2, 3 (tentative 1994) and SPOT 4 (tentative 1996) Sensor System Configurations

(Source: Clark A. Nelson, 4/28/92)

Sensor	Spectral	Spatial ²	Temporal	Quantization
XS1 ¹	.50–.59 μ m	20 x 20 m	pointable	8-bits.
XS2 ¹	.61–.68 μ m	20 x 20 m	pointable	8-bits.
XS3 ¹	.79–.89 μ m	20 x 20 m	pointable	8-bits.
XS4 ²	1.58–1.75 μ m	20 x 20 m	pointable	8-bits.
Pan ¹	.51–.73 μ m	10 x 10 m registered	pointable	8-bits.

Table 3.—SPOT 1, 2, 3 (tentative 1994) and SPOT 4 (tentative 1996) Sensor System Configurations—Continued

(Source: Clark A. Nelson, 4/28/92)

Sensor	Spectral	Spatial ²	Temporal	Quantization
Veg ²	4-5 bands t.b.d.	1 km x 1 km, 2500 km swath, daily coverage of Earth.	unknown	
Across-track stereo.				

¹These bands are found on SPOT 1, 2, and 3 (built and ready to launch when SPOT 1 or 2 wear out)

²These additional bands will be on SPOT 4 (under construction).

Table 4.—SPOTS Sensor System Configuration (tentative 2000)

(Source: Clark A. Nelson, 4/28/92; Nanz quoted in Stephens, 1991)

Sensor	Spectral	Spatial ²	Temporal	Quantization
XS1	t.b.d.	possibly 10 x 10 m ..	pointable	8-bits.
XS2	t.b.d.	possibly 10 x 10 m ..	pointable	8-bits.
XS3	t.b.d.	possibly 10 x 10 m ..	pointable	8-bits.
XS4	t.b.d.	possibly 10 x 10 m ..	pointable	8-bits.
Pan	t.b.d.	will be 5 x 5 m	pointable	8-bits.
Veg	t.b.d.	t.b.d.	unknown	
Along track stereo.				

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"IN YOUR OPINION, HAS COMMERCIALIZATION OF R.S. DATA HAD A POSITIVE OR NEGATIVE IMPACT ON REMOTE SENSING RESEARCH?"

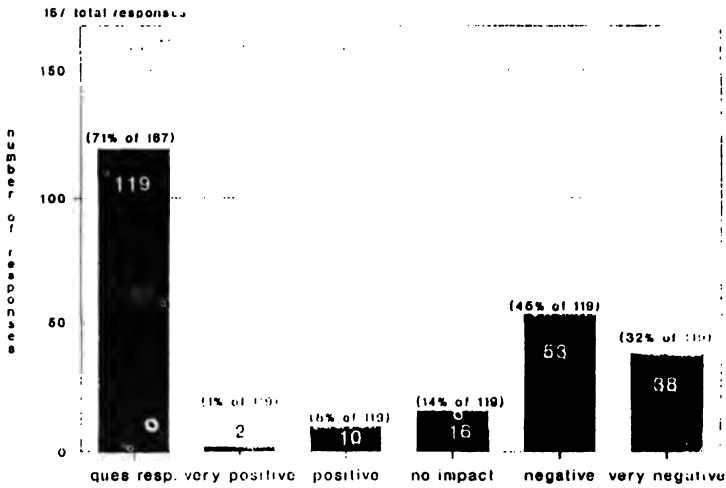


Figure 1. Results of a questionnaire administered by Dr. John E. Estes and David R. Jones, Department of Geography, University of California at Santa Barbara.

"IN YOUR OPINION, HAS COMMERCIALIZATION OF R.S. DATA HAD A POSITIVE OR NEGATIVE IMPACT ON REMOTE SENSING EDUCATION?"

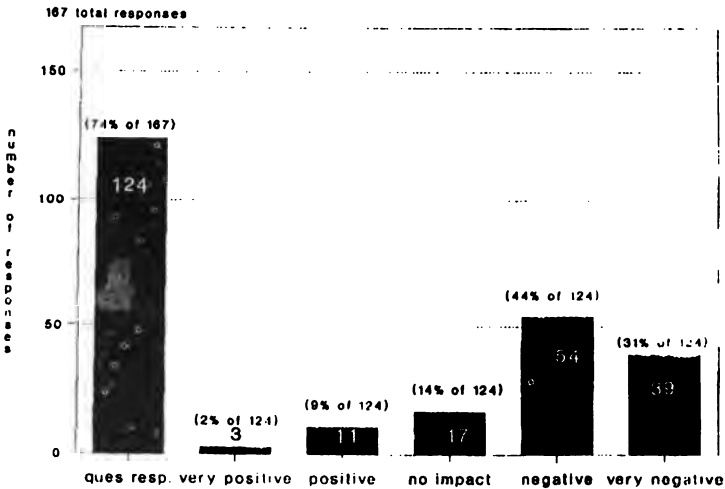


Figure 2. Results of a questionnaire administered by Dr. John E. Estes and David R. Jones, Department of Geography, University of California at Santa Barbara.

**"HOW STRONGLY WOULD YOU SUPPORT THE FEDERAL GOVERNMENT
TAKING OVER THE OPERATION OF THE LANDSAT SYSTEM?"**

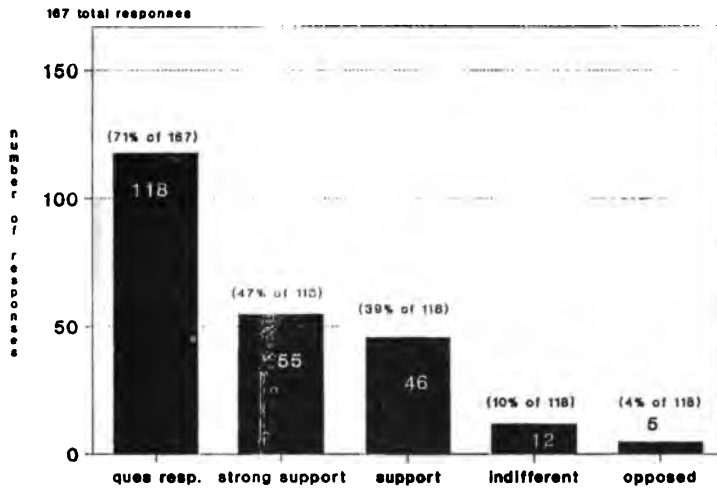


Figure 3. Results of a questionnaire administered by Dr. John B. Estes and David R. Jones, Department of Geography, University of California at Santa Barbara.

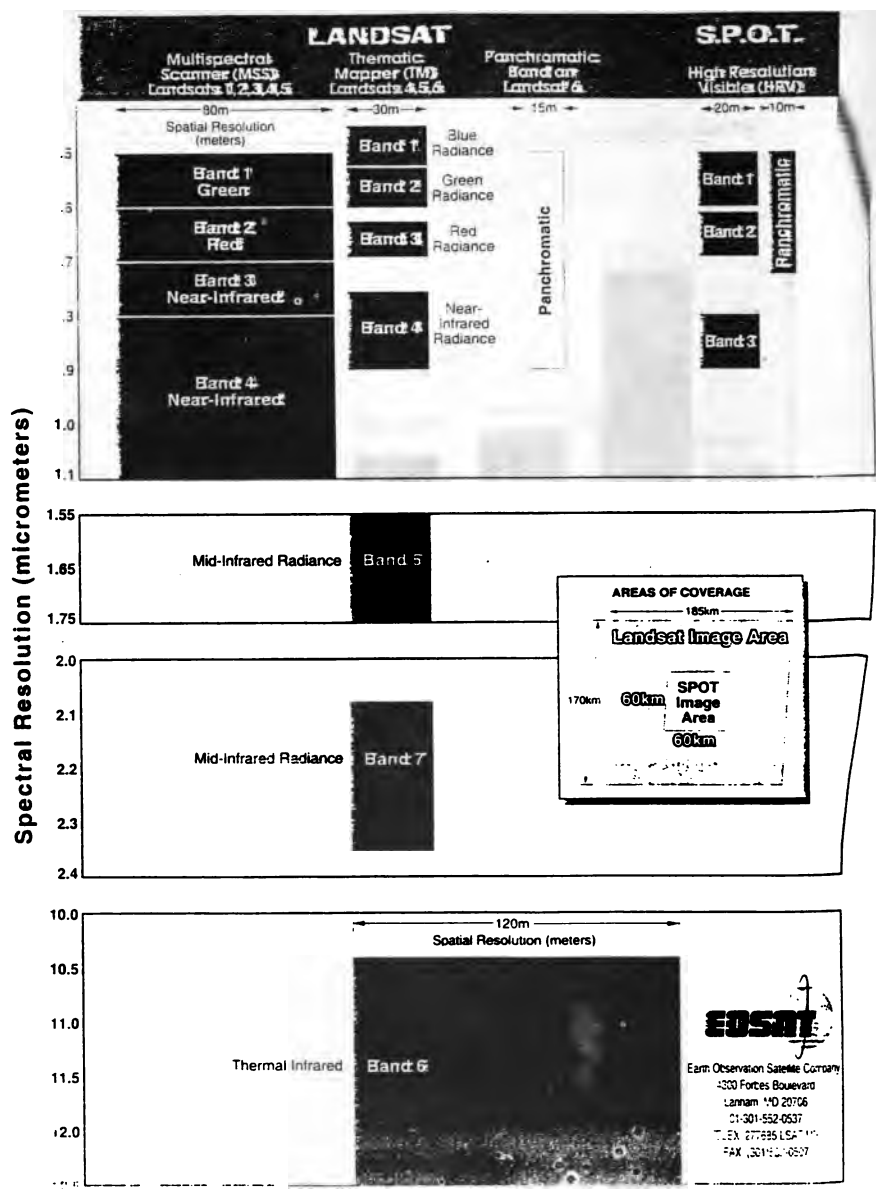


Figure 4. Summary of spatial and spectral resolution characteristics of Landsat Thematic Mapper (TM), Multispectral scanner (MSS), and SPOT High Resolution Visible (HRV) sensor systems (Source: EOSAT).

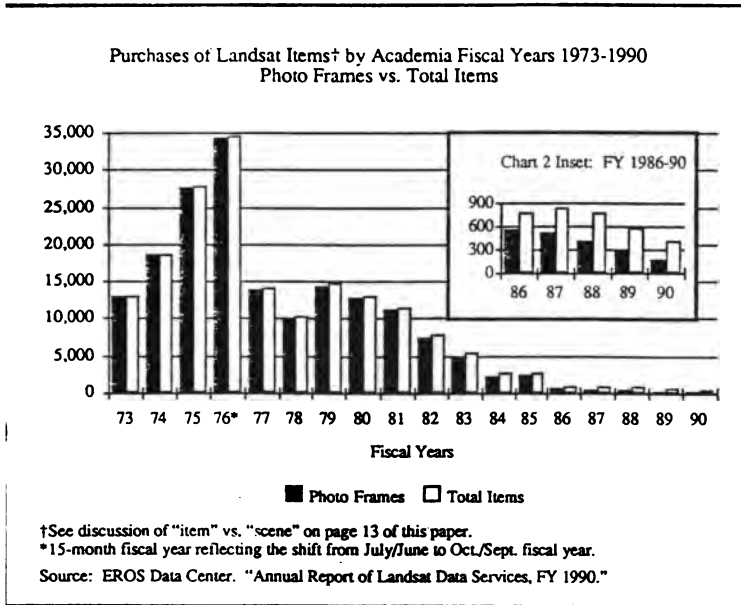


Figure 5. Purchases of Landsat items by academia for Fiscal Years 1973-1990 listing photo frames and total items (Source: Silvestrini, 1991; EROS Data Center "Annual Report of Landsat Data Service, FY 1990")

Senator GORE. Could you introduce our next witness, Senator?

Senator PRESSLER. This is Charlotte Black Elk. We are very proud of her. She is a very distinguished American Indian leader. She is also a very respected land resource manager. And interesting enough, her grandfather, Ben Black Elk, was the first satellite image ever commercially broadcast on Telstar in 1963. So there is a little bit of interesting personal history.

Senator GORE. But Charlotte Black Elk, we are very proud to have you here. I believe you are speaking on behalf of the National Congress of American Indians; is that correct? No, you are speaking on behalf of yourself. Go right ahead. I am sorry.

STATEMENT OF CHARLOTTE BLACK ELK

Ms. BLACK ELK. Thank you, Senator Pressler. Mr. Chairman and Senator Pressler, iyaha iyuxkinyan napeciyuzapi. My name is Charlotte Black Elk. I am the administrative officer for the Oglala Sioux Tribe Parks and Recreation Authority. I understand that my previous correspondence to Senator Pressler on this legislation will be incorporated into the record.

I am a manager of tribal wildlife, recreation, geological, and paleontological resources. I am not an expert in remote sensing or satellite technology. I will defer to my colleagues on the panel, especially my junior colleague, Mr. Jensen here, to speak on technology issues.

Senator GORE. Could you move that mike? Could you point the microphone downward a little bit? Thank you very much.

Ms. BLACK ELK. I live on the Pine Ridge Indian Reservation in southwestern South Dakota. Our reservation is located in a geologically unique area where four geological structures come together—the Pine Ridge Escarpment, the Sandhills, the Great Plains, and the Badlands.

Our reservation also has the very sad distinction of being located on the poorest county in the United States of America, and has been in the 1970, 1980, and 1990 censuses. We have great experience and foundation to speak on our concerns of cost.

During the early years of World War II, the northern tier of the Pine Ridge Indian Reservation was taken under eminent domain condemnation and used as an aerial gunnery range. The Parks and Recreation Authority is preparing to clear this area of spent munitions, unexploded ordnance, and shell casings so that we could move forward with a wildlife habitat restoration and paleontological restoration and protection plan. We have some of the greatest paleontological resources available in North America within our reservation.

We also saw the potential to train our rangers in this technology field. As people who supervise rangers, we have great concern that they not be too focused on law enforcement activities and work in resource protection.

We saved our money. We had to sell trophy buffaloes and reduce our herd. We finally got some satellites. We were aware that Landsat satellite images existed. We wanted to get our hands on some images and look at preparing a plan for our reservation.

We approached EROS in southeastern South Dakota and we were referred to EOSAT. The preliminary price projection, without a specific request order for calculation, was \$200,000 to \$300,000 per request. And we were told that we may need a whole array of chronological and seasonal spots for data.

Then there was a problem that even if we got all of this stuff, we would not know how to understand it or how to deal with it. I know that many other tribal governments and nonprofit agencies have had similar problems.

I may not be familiar with the social and cultural intricacies of the American economic system, but it seems to me that we paid for the research and development of this satellite system. We paid to launch it. We pay a subsidy to the commercial monopoly. And we still have to pay a high fee to get this information.

We asked if we could be treated like a government. I said, I am from the Pine Ridge Indian Reservation, the Oglala Sioux Tribe, and the response at EOSAT is, "Huh? What is that?"

Because of my experience, I want to suggest the committee's consideration of an amendment to incorporate centers which are a network of college or university-based Landsat application and technology transfer facilities. These centers will assist people like me to use the tools of modern technology while keeping our institutions of higher learning current with technological advances. It does not substitute a business center. We need to know how to function with this technology.

I also want the committee to consider specifically including tribal governments into the definition of users. There are many aspects of the Federal Government that do not know that we are still here.

I also would like to offer the idea of a Landsat advisory council, which will help chart the course for the future. I am an American Indian. I know very well what happens to the high ideals of leadership when bureaucrats are allowed to interpret and implement policy. And I am also a rare Indian Republican [Laughter] who firmly believes in the principles of local government and citizen participation in every level of government.

What we have heard from the previous panel makes it sound like everything is under control. I do not think that is so. I think the Landsat Policy Act of 1992 or the Land Remote Sensing Act provides a wonderful opportunity to set a new agenda for participatory education, small business development, planning, and resource conservation, preservation, and development. And I think, importantly, it sets a specific direction for this program.

When my grandfather was the first satellite image that was every commercially broadcast in 1963, he traveled the world and spoke of how this new manmade star was going to bring people together; how some day we would know that this was one world and that we must all work together to be relatives of our mother, the Earth. I feel it is through our advances in all fields of technology that we have damaged our mother, and we will have to turn to technology to make right what we have done wrong.

Mr. Chairman, I know that you will hear many opinions regarding this issue—some supportive, some in opposition, others telling you to do nothing. You hold the very difficult and oftentimes solitary position of being what we call wakicunza—deciders. It is your responsibility to make a decision that will benefit all of the people, not just a few, not just your friends, not just those who have power or access, but all of the people.

Pila mayapi.

[The prepared statement of Ms. Black Elk follows:]

PREPARED STATEMENT OF CHARLOTTE A. BLACK ELK

Mr. Chairman, Senator Pressler, members of the Sub-Committee on Science, Technology, and Space, I am honored for this opportunity to speak on S. 2297.

My name is Charlotte A. Black Elk, I am the Administrative Officer for the Oglala Sioux Tribe Parks and Recreation Authority, and an instructor for both Oglala Lakota College and Sinte Gleska University. I understand that my correspondence to Senator Larry Pressler on this legislation will be incorporated into the record.

I am a manager of tribal wildlife, and recreation, geological, and paleontological resources. I am not an expert in remote sensing or satellite technology. I will defer to my able colleagues on the panel to speak to technology issues.

I live on the Pine Ridge Indian Reservation in south western South Dakota. Our reservation is located in a geologically unique area where four geological structures come together; the Pine Ridge Escarpment, sandhills, Great Plains, and Badlands. Our reservation also has the sad distinction of being located on the poorest county in the United States.

During the early years of World War II, the northern tier of our reservation was taken under eminent domain condemnation and used for an aerial gunnery range. The Parks and Recreation Authority is preparing to clear the area of spent munitions, unexploded ordnance and bomb casings so we could move forward with a wildlife habitat restoration and paleontological protection plan. I also saw the potential to train our rangers in this technology field.

We saved our money, and bought computers. We were generally aware of the Landsat satellites and planned to get our hands on some satellite images.

Then we approached EROS in south eastern South Dakota and were referred to EOSAT. The preliminary price projection, without a specific request order for calculation, was \$200,000 to \$300,000 and maybe higher if we ordered a chronological

and seasonal array. And there was the problem that even if we could pay for the information, we probably couldn't understand or use the data anyway.

Maybe I don't fully comprehend the social and cultural intricacies of the American taxpayer system: but it seems to me that we paid for the research and development of the satellite, paid to launch it, pay a subsidy to the commercial monopoly and still have to pay a high fee to get the information.

Because of my experience, I want to suggest an amendment to incorporate centers which are a network of college or university based Landsat applications and technology transfer facilities. These centers will assist people, like me, to use the tools of modern technology while keeping our institutions of higher learning current with technological advances.

I also want to offer the idea of a Landsat Advisory Council which will help chart the course for the future. I am an American Indian, I know very well what happens to high ideals of leaders when bureaucrats are allowed to interpret and implement policy. I am also a Republican who firmly believes in the principles of local control and citizen participation in every level of government.

The "Landsat Policy Act of 1992" provides a wonderful opportunity to set a new agenda for participatory education, small business development, planning, and resource conservation, preservation and development. More importantly, it sets a direction for the program.

I also support the principle of paying a reproduction cost for any data we receive. I do not support paying a high profitable level for a monopolized business to keep us in a technological dark age. I think a fair comparison would be the census data that is collected for a specific need of the government.

Yesterday morning I saw a paid advertisement on the EOSAT organization in the "Washington Post" and it reminded me of a story the Lakota have about Iktomi—the trickster. Iktomi sings to the ducks "dance with your eyes closed, dance with your eyes closed, and you will live a long time." As they dance with their eyes closed, Iktomi eats up the ducks.

My grandfather, Ben Black Elk, was the first satellite image ever commercially broadcast, on Telstar in 1963. He often spoke of how this "new man-made star" was going to bring people together, how someday we would know that this was one world and we must work together to be relatives of our mother, the earth. I feel that it is through our advances in all fields of technology that we have damaged our mother and we will have to turn to technology to make right what we have done wrong.

Mr. Chairman, I know that you will hear many opinions regarding this issue, some supportive, some in opposition and others telling you to do nothing. You hold the difficult and often times solitary position of being "wakicunza" deciders. It is your responsibility to make a decision that will benefit all of the people, not just a few, not just your friends, not just those who have power or access, but all of the people.

Pila mayapi.

Senator GORE. Thank you very much.

Our final witness on this panel is Dr. Frederick Henderson, President of the GEOSAT Committee based in Norman, OK. Welcome, Dr. Henderson.

STATEMENT OF FREDERICK BRADLEY HENDERSON III, PRESIDENT, THE GEOSAT COMMITTEE, INC.

Dr. HENDERSON. Thank you, Mr. Chairman. I appreciate the seating at the table today. A main request in my testimony is "A seat at the table," and I appreciate the opportunity to demonstrate it.

I also share the last speaker's concern that all of us are involved in this technology and that is the point I wish to make.

Senator PRESSLER. Pull that microphone a little bit closer or maybe my hearing is—I am getting a little older.

Dr. HENDERSON. I am sorry. I know many people would perhaps not agree in this room, but I want to make a point in my testimony that the resource community, the industries that provide the basic resources that built this room and all of our technology, equipment

and so on and so forth; are a vital part of this country and they have a role to play in supplying the resources that are required to have a strong defense and to worry about our environment, to provide us with that wealth.

What I would like to comment is that we have been testifying since 1972, when I first testified in the Senate before Senator Schmitt and Senator Stevenson on the subject of Landsat and its use for industry. It is frustrating to still be here testifying on that same question.

We are the only representative for remote sensing by the many people who use geology in industry and other places, and the resource industry itself. If we terminated the Committee today after 16 years—we never intended to be a permanent committee, but we could say we have declared victory because the sensors we asked for are basically in space with the advent of the Japanese and European space programs.

The problem is they are not in U.S. programs, and those sensors compete with this Landsat program which is going to be cloned in the United States. This pyrrhic victory, as far as I am concerned is partly because we have been speaking on behalf of an industry that is not represented in the Government councils, much perhaps like the Indians. I think that is a very important point.

We have no "seat at the table" in the decision process of how this technology should benefit this segment of our economic sector. This critical institutional gap between industry and Government is detrimental to our competitiveness for global resources. I will explain, that is important to the resources for the children, your children and our grandchildren.

This also is inhibiting our ability to work with Government in trying to find ways to do cooperative research on environmental applications of this technology.

As I said before, the principal request of our testimony today is to seek a seat at the table for the resource and related industries as proposed in H.R. 3614 by the creation of a Landsat Advisory Council. I might just add, since it has been mentioned, I served on the Halbouty committee with great honor and one of the things we recommended there was that there should be for this system a board of directors which would have all the segments of society, who would have some say as to how the technology should be built. As well as how that data should come out in a way that would benefit all of us. A lot of those recommendations were not met by the present system.

I want to comment about remote sensing in our industries, since they have changed a lot over 16 years. In recent years, our original focus was on geology. We are now looking at oceans and we are very interested in environmental applications because we must be. We contribute to the problem, but we do not do it by ourselves.

In the late 1970's and early 1980's when Geosat was formed, the large companies that I worked for bought raw data and did in-house processing for their own internal value-added service. Today that is changing dramatically. Because of metal prices in the early 1980's the mining business went out of the exploration business for a long time. Today the oil business is also on the verge of going out of exploration business in many respects, perhaps to the glee

of some. However, I would ask them, "Where they will get their future resources?"

Let me give an example that I hope might make some sense to some people in this room. The major petroleum companies that I work for have experienced their fourth 10- to 15-percent reduction in personnel and budget for technology research and development, including Landsat; not just Landsat, but all technology.

Their service section and research groups have been cut 10 to 15 percent four times in the last 8 years. If I make that parallel comparison to the House of Representatives—I would not presume to do it to the Senate. Of the 435 Members of Congress today, there would be only 300 to do the same task. That is our problem.

These major cuts in personnel and capability are being coupled with a shift to resources found outside the United States. These structural changes, in cutting back our capability to do things inside our own businesses both this kind of data and technology, is not just remote sensing, but also shifting by economic and other factors outside the United States. These are structural changes that are deep, they are institutional, they are long-term and they will not be changed by immediate changes in price and basic materials.

The easy stuff in the United States has been found, but to supply our domestic consumption we must continue to explore outside the United States. I think that is extremely important to understand.

The continued needs for the resource industry, as reflected to this sensor technology, have been documented in the many testimonies we have given over the last 15 years.

Regarding the issues before you today, we of course support a strong continuity for the Landsat program. We also support the nondiscriminatory access data principle and we question the issue raised in the previous panel, over private satellites. If you allow the private satellites proprietary use of data you must do that clearly understanding what it does in negotiating for outside, data systems outside the United States.

The best geology satellite is the Japanese satellite. We do not see that data coming out on the open market yet. Open skies is one of the few leverages that we have to argue the case to acquire their data for our competitive industries.

We urge equitable pricing for the Landsat data. We are willing to pay a reasonable price, however, we feel it is wrong that a Government-supported system should be unnecessarily discriminatory toward industrial users when other potential competitors of our systems can acquire data at marginal costs.

Again, I want to emphasize the importance of what is in the findings of both House and Senate bills. That is to encourage the broad availability of this data to all sectors of society.

In order to do that, I would like to ask the Senate to support the principles under the House Advisory Council section of H.R. 3614 and Senator Pressler, I hope you will consider that in your bill. We think that is important. That was also again recommended back in the Halbouty committee days to create a board that would advise the Government that is running a Government program for all users, not just defense and environment.

Our understanding of this legislation again says that this oversight will be a NASA responsibility, of the NASA and DOD management teams. I would like to make a couple of points on my red light if I may, being at this end of the table.

Remote sensing will play a significant role in competition for global resources. We compete overseas as U.S. industry with public and foreign, private and public resource organizations who have access to subsidized data that we do not have. What is often overlooked in this thing is that our companies must provide the resources that create wealth to afford a strong defense, intelligence community and a strong environmental program.

I want to emphasize that the basic thinking of the Club of Rome's in the 1970's is still correct. We are limited, in terms of finiteness, to our basic resources in this world. What scares me is the impending doubling of the world's population in two generations.

As I said, Senator Gore, to you at one time, that is the time my grandson is my age. He will have to live with 5.5 billion net new souls who have to be housed, have jobs, and some form of energy and some kind of a decent living.

So, we feel that this technology must play a role in that. We are concerned, of course, also that international competition for global resources may become military disputes or at least military concerns.

I hope, Senator Gore, you would agree, in your excellent book you touched on this, but if you will write a sequel, they are always looking for sequels these days—man's greatest impact on global environmental change in the next two generations will be the physical doubling of the world's population, and it is necessary that we build collective capabilities to provide basic resources for these souls in an economically and environmentally secure manner.

In that mode, the title of your book, "Earth in the Balance" is an excellent title. It is a good book. I recommend it be read. I want to emphasize that we hope that this technology will be considered a national asset, a public good. It will serve the needs of our national intelligence community. It will serve NASA and the global change research program and our ability to make wise decisions about our resources and our environment.

And also, it will help serve our needs to provide resources to our children and grandchildren. On their behalf, thank you.

[The prepared statement of Dr. Henderson follows:]

PREPARED STATEMENT OF DR. FREDERICK BRADLEY HENDERSON III

I. INTRODUCTION

On behalf of the Geosat Committee and the industrial resource community we represent, I want to thank you for the opportunity to testify before this committee on the Land Remote Sensing Policy Act of 1992.

The Geosat Committee was organized in 1976 to demonstrate our recommendations to NASA on technical enhancements to the Landsat Multispectral Scanner (MSS) that would improve satellite remote sensing for geological applications worldwide.

In the succeeding sixteen years, we have become the only non-government spokesgroup before Congress and elsewhere on behalf of remote sensing interests of the geological profession and the resource industries in general.

If the Geosat Committee went out of existence today, it is unclear who could represent the remote sensing interests of this important multi-industry segment of the

U.S. national economy. Were we to disband, we could declare victory as our 1976 sensor recommendations are, or soon will be, entirely in space. However, these recommended capabilities are aboard non-U.S. satellite systems and are in direct competition with the Landsat program.

This pyrrhic victory in the U.S. may be because the Geosat Committee has spoken on civil remote sensing issues on behalf of the U.S. user industries' interests which are not represented institutionally within the federal government. This U.S. problem is in stark contrast to competitive satellite producing countries where the user industries have a "Seat at the Table" in policy development and implementation for their national satellite remote sensing programs.

This critical U.S. institutional industry-government gap is detrimental to U.S. exploration remote sensing development, which in turn restricts competitiveness in the global market place. Furthermore, this void inhibits the use of this vital technology in developing industry-government cooperation which would improve global environmental management while also assuring the provision of basic resources needed by our society.

A principal request of our testimony before this committee today is to seek Senate support for assuring a "Seat at the Table" for the U.S. resource and related industries as proposed in H.R. 3614 Sec. 201E. This section creates a Landsat Advisory Council to guide the future of the Landsat program and recognizes such action as being in the national economic interests of our society.

II. REMOTE SENSING AND THE CHANGING U.S. ENERGY AND MINERAL RESOURCE INDUSTRIES

The Geosat Committee's focus since 1976 has been on geologic applications for satellite and airborne remote sensing.

In recent years, this focus has broadened to include remote sensing for offshore oceanographic, exploration, engineering, and environmental applications. This broadened scope also includes interest in developing initiatives for proposed industry-government cooperative research and earth observations applications for global environmental study and management. We have just completed a report to be delivered to the U.S. Committee on Earth and Environmental Sciences (CEES) on suggestions for applying industry research to the U.S. Global Change Research Program. This document was undertaken to communicate our interest in jointly establishing the geophysical "truths" of the new measuring and monitoring remote sensing technologies in global change study and environmental management. This document offers suggestions for cooperative industry-government pilot research projects. A copy of the report suggestions is respectfully submitted for the record.

During the late 1970's and early 1980's, the Geosat Committee was supported mainly by large petroleum and mining companies who purchased raw Landsat and later SPOT data and then developed their own in-house value-added information for their internal proprietary uses.

Beginning in 1981, with general mining company responses to falling global metal prices and in 1983 with major ongoing restructuring in the petroleum industry, these large companies began downsizing their internal research and technical services departments and dropping their in-house remote sensing research and service capabilities.

This year, the major petroleum companies of the Geosat Committee have experienced their fourth 10-15 percent reduction in their research and technical services personnel and budgets in the last eight years. To put this in comparative perspective, if the four hundred thirty-five members of the House of Representatives had suffered the same cuts over the last eight years, there would be less than three hundred Congressmen left today to accomplish the same tasks. The same reduction in the U.S. Senate could be devastating.

These significant industry cut backs are coupled with major corporate strategy shifts to decrease or eliminate domestic exploration and focus on exploration for resources outside the U.S. to supply U.S. domestic consumption.

These structural changes are deep, institutional, long-term and industry-wide. Some senior management project the future survival of only five or six major domestic petroleum companies. This should alarm young Americans when they realize that there is not Cabinet-level government agency responsible and accountable for assuring that the future U.S. society has access to needed global energy and mineral resources.

The easy-to-find energy and mineral resources in the U.S. are gone. A Director of the Geosat Committee recently stated that "Data access isn't a sexy issue, until you don't have any." I would add to this and say to those in the U.S. who don't care

about the U.S. resource industries, "Your energy and mineral supplies aren't very sexy issues, until you don't have any!"

For remote sensing, these major structural changes in the petroleum and mineral industries will mean greater future reliance on remote sensing information provided by the value-added industry. While this may be good for the value-added industry which is struggling, it bodes ill for long-term U.S. industrial research on applied remote sensing.

III. CONTINUING REMOTE SENSING NEEDS FOR THE U.S. RESOURCE INDUSTRIES

In the previous twenty-six Congressional testimonies of the Geosat Committee, our resource industries' sensor needs have been well documented. However, our main concerns before your committee today are with our continuing needs under the policy issues being considered in the current legislative proposals to change the 1984 Landsat Commercialization Act. As requested, our testimony deals not with the specific language in S. 2297 and H.R. 3614, but with the issues to be resolved between the House and Senate which will set future policy for the U.S. land remote sensing program.

First, we support "the continuity of the Landsat program" and the continued evolution of advanced remote sensing capabilities such as proposed in the Technology Demonstration section of H.R. 3614.

Secondly, we urge "equatable pricing" for all customers of Landsat data. As explained in detail in our testimony and answers to directed questions before the House Committee on Space, Science and Technology in November and December of 1991, the Geosat Committee, Inc. does not support multi-tiered pricing as we understand H.R. 3614. While we are willing to pay reasonable prices for data, we do not support industrial users paying discriminatory higher prices for data from a government satellite system supported by taxpayer dollars, while other potentially competitive users pay marginal costs. Multi-tiered pricing as proposed by H.R. 3614 will be difficult to manage, hard and expensive to police, inhibiting to new commercial developments and investments, anti-American, anti-industry, and anti-competitive while favoring subsidized foreign users. It is also generally contradictory to the findings of both S. 2297 and H.R. 3614 which encourage "broad civilian use" of land remote sensing in the best interests of the nation.

The Geosat Committee seeks Congressional assurance that the Landsat program, being further developed and managed by the new Department of Defense (DOD)/NASA management programs, will strive to enhance the optimal non-discriminatory availability for these data to all sectors of U.S. society.

In order to enhance such data availability, we request that your sub-committee recommend U.S. Senate support of the creation of a Landsat Advisory Council as proposed in H.R. 3614. In our House testimony last November, we urged the creation of a National Remote Sensing Council for all U.S. civil remote sensing systems to include Landsat, EOS, and EOS-DIS. As S. 2297 and H.R. 3614 deal only with Landsat, we seek your support in the final House and Senate Landsat Remote Sensing Policy legislation for the creation of a truly meaningful Landsat Advisory Council. We urge that the basic U.S. resource industries be assured a "Seat at the Table" by substantive representation on the Landsat Advisory Council. We further recommend that the reporting procedure be strengthened by reporting directly to the Director of the National Space Council, Congress, and to the NASA Administrator to assure that industrial as well as other legitimate non-DOD/NASA needs are adequately considered.

These recommendations, in support of the Landsat Advisory Council, are in line with the 1982 recommendations to Department of Commerce Secretary, Malcolm Baldrige, by the Land Remote Sensing Satellite Advisory Committee (LARSSAC) chaired by Michel T. Halbouty to establish a Board of Directors for the Landsat program consisting of representatives of government, industry, and academia and reporting to the President of the United States.

IV. ON THE IMPORTANCE OF RECOGNIZING THE RESOURCE INDUSTRY NEEDS IN DEVELOPING POLICY FOR FUTURE U.S. LAND REMOTE SENSING

In both S. 2297 and H.R. 3614, in agreement with recent National Space Council decisions, provision is made for funding and oversight management of the Landsat program primarily by the DOD for their intelligence needs and by NASA for their global change research needs.

After the 1979 Landsat privatization decision and the ensuing EOSAT commercialization experiment starting in 1984, the government seems to have decided to back-track and develop and "integrated civil-military satellite remote sensing system" as considered and discarded by the government in 1978-1979.

Our understanding of the current proposed Landsat Management Plan makes all non-DOD and NASA global change user needs the oversight management responsibility of NASA. In recent years, NASA has shown little interest or experience in serving the needs of the U.S. user industries.

While we are confident that Landsat will well serve DOD intelligence and NASA global change research needs, we are concerned that no real provision is being made for U.S. land remote sensing to serve the basic resource needs of this country. Fundamental to the continued economic strength of the United States is a sound economy based on access to both domestic and, increasingly, on foreign petroleum and mineral resources. In spite of political election gobbledygook, there is simply no acceptable economic way in which the U.S. can reduce its dependence on imported energy and mineral supplies in the next decade.

Remote sensing will play a significant role in ensuring U.S. industry remains competitive in securing and utilizing global resources. U.S. industry competes overseas with foreign public/private resource organizations who often have access to subsidized state-of-the-art remote sensing technology not readily available to U.S. industry. Current legislative proposals that would lead to discriminatory pricing and availability against U.S. resource industrial users place further anti-competitive economic burdens on such U.S. users.

What is often overlooked in the current debate to provide cheap Landsat data for security intelligence and for global environmental change research is that secure access to global resources is in the fundamental interest of the American people. Access ensures our ability to afford a strong defense and provide international leadership in global environmental stewardship.

The basic thinking of the Club of Rome's "Limits to Growth" in the early 1970's is valid today. The earth has finite limits to economic base resources. The impending doubling of the world's population in just two generations (when my grandson is fifty years old) places super critical importance on the U.S. and all nations to better understand global energy and mineral, as well as food and fiber resources in order to wisely provide for and meet these basic resource needs of this ballooning world population. International competition for these global resources for this doubling population may become major issues of military dispute and national security concern.

Clearly, man's greatest impact on global environmental change in the next two generations will be the physical doubling of the world population and our collective need to provide basic resources for these net new 5 billion humane souls in an economically, environmentally, and secure manner. It should be understood by the American people that it is in their best interest for the U.S. resource industry to be involved with government in securing access to global resources for domestic consumption and access to data for cooperative industry-government research to better understand and manage our environment.

V. CONCLUDING COMMENTS

The title of Senator Gore's recent book "Earth in the Balance" is pertinent to our concerns on the significance of the future development of vital civil land remote sensing in the U.S. and in the world.

We believe that it is in the national interests of the people of the United States that the U.S. land remote sensing programs strike a balance in the needs of

- our national intelligence communities,
- NASA and the U.S. Global Change Research Program and society to understand man's impacts on natural global change leading to better industry-government wisdom in managing our environment, and
- our global resource discovery and development requirements in an increasingly competitive and ballooning world population.

Mr. Chairman, on behalf of our children's and grandchildren's generations who will live with and be the most affected by our deliberations and resulting legislation today, I personally ask for the support of your Committee in the fundamental ideals I have outlined above.

On behalf of the Geosat Committee, thank you for your consideration.

Senator GORE. Thank you very much for that excellent statement and parts of it were among the best I have ever heard. [Laughter.]

People will not believe I did not put you up to that, but I appreciate that so much. Thank you very much.

Again, I will have a few questions. I think we have heard five excellent presentations and I want to thank all members of this

panel. I will have a few questions and then turn it over to Senator Pressler.

Dr. Blackwelder, I had to step out of the hearing room briefly during your statement, but I read your statement carefully and heard a portion of it as you presented it. You said that the Nature Conservancy has indicated it would use 10 to 100 times as much Landsat imagery as at present if the data was reasonably priced.

What type of environmental research is not now being conducted because of the present cost and unavailability of Landsat data?

Dr. BLACKWELDER. One of our sources of information is that frequently when you want a fly over of tropical forests, the cameras might not even be turned on. So, it seems to us that if we are not really gathering the data that we need and in particular tropical deforestation is one of the most urgent global problems, what do we have the satellites up there for?

And so if you were to ask for data you might be told, sorry, the cameras were not on and with the Earth summit coming up in Brazil this is one of the questions where a nice 20-year analysis of data on tropical rain forests would have been especially timely and illuminating for the debate and we do not have it available.

Senator GORE. Well, that is an excellent and clear example. Indeed, when our subcommittee took the time in a lengthy series of Earth science round tables, we compiled a list of what appeared to be a consensus list of the 23 most important questions which remain to be fully answered about the global ecological system.

Several of those questions depended for their answers on a data base about what changes have occurred on the surface of the land mass of the Earth? In looking at what information would be available to answer those questions, one looks naturally and immediately to Landsat. It was in that process that I personally was surprised to discover that in fact, as you indicate, most of the time, the cameras are turned off, because McDonalds does not want to put a new restaurant in the middle of the Amazon. So, there is no commercial demand for that image and so the cost of taking the picture is not incurred by the private company and so the images are not even created to begin with.

They do not go to the EROS data center and the record is not compiled and meanwhile we busily go forward with our plans to put a new multibillion suite of satellites up at the end of the decade, to start taking pictures for some reasons that exactly overlap with, not all, but for some reasons, it exactly overlaps with the reasons why we want the Landsat data base to be complete.

Now in recent months EOSAT has come forth with a number of proposals to make this data available to environmental users at reduced cost. They argue that legislation is not needed, that the problems which now exist can be resolved by the various parties working together.

Have these steps helped in your view? Has it been enough to meet the data needs of environmental researchers and do any of these proposals from EOSAT hold the promise of solving this problem without legislation?

Dr. BLACKWELDER. Mr. Chairman, we are not satisfied. We think that there is overwhelming and abundant evidence for legislation,

exactly along the lines of Senator Pressler's bill with some of the amendments which I suggested in the letter to you.

There is a very serious problem. The changes are only being postured now—the ad in the Washington Post and the publication in the Federal Register of this—only because the situation has gotten to a critical stage. And I think it is only the Congress that can rescue the situation now.

Senator GORE. Now earlier we had a discussion about Landsat 6. You argue that it is essential, the new data and pricing policies proposed in Senator Pressler's bill go into effect with the launch of Landsat 6 rather than waiting for the launch of Landsat 7.

You stated that you are not convinced that the buyout of the EOSAT data rights would be as expensive as some have indicated. What makes you believe that and can you estimate what that kind of buyout might cost the Federal Government?

Dr. BLACKWELDER. We have heard figures from EOSAT saying that it might be \$150 to \$200 million for buyout costs, but it is a question that we are urging this committee to explore because I think there are all sorts of ways in which, given the serious nature of what has been occurring, the dropoff in data as I indicated from the charts, that there are serious grounds for rethinking this whole thing.

And therefore, it may be the case that for \$50 million or even less there might be a possibility of rectifying the situation. Regardless though, the overwhelming benefits which are being denied the American public would justify even the higher level costs in our judgment.

Senator GORE. Even though that would essentially mean the taxpayers would end up paying three times for the Landsat 6 data: Once to build the spacecraft; a second time to buyout the Landsat data rights; and the third time to have the Federal Government operate the Landsat system.

You are saying that even those three expenditures would still end up being less than the costs incurred by just turning the cameras off, not having the images, not doing the research, et cetera?

Dr. BLACKWELDER. It is maybe like an analogy with a festering wound, you have to get rid of the problem. It may cost you a medical bill to deal with it, but you do not want to let that situation persist, and you would be better off in the long run for having done it sooner rather than later.

Senator GORE. Boy, that is a tough message to deliver. I mean, you are recommending that we essentially go to the taxpayers of this country and say that the country made a serious mistake. President Reagan and his budget director convinced the country to do something that Republicans and Democrats alike now agree was really stupid and so we have to undo it and it is going to cost a lot of money to undo the damage. That is basically your message.

Dr. BLACKWELDER. That is right.

Dr. HENDERSON. Senator Gore, may I just say that that is the message, if environmental problems are as important as you think they are, then the message must get to the taxpayer, it is everybody's environment. It is everybody's environment.

Senator GORE. I certainly agree with that. Now Mr. Thibault, much of the discussion has focused on this pricing policy for future

Landsat systems, yet the administration has seemingly asked the Congress to defer taking any action on legislating the specific pricing policy.

In your view, what are the pros and cons of a hands-off approach? How would the uncertainty created by a lack of legislation affect the industry that you represent which I might call the value-added industry in this sector?

Mr. THIBAUT. I think the arguments made for retaining some flexibility within the executive branch for arriving through negotiation at a price has some attractive features, but I am much concerned about how those negotiations will take place and from the discussions heard this morning, it is clear to me that the research community will be well cared for in any negotiations.

Dr. Fisk suggested that it was possible for NASA to negotiate with EOSAT for Landsat 6 data at a reduced price for global researchers, but it was not possible for EOSAT to abandon its contractual rights to those data and negotiate a lower price for other users.

In fact, those who are doing the negotiating have one interest in mind and that is to provide minimally priced data to their constituents. We, industry, are not among their constituents. I think the simple proposal in S. 2297 is the proper answer.

Industry must make investments and many of the value-added companies are small companies. I think of Pacific Meridian Resources, Kass Green from that company testified in the House and I think has corresponded on this subject with this committee. Her small company, which is 4 years old started with a little bit of money, 4 people, and today employs 50 people.

That company had to make investments. They had to invest in capital equipment, processing equipment—

Senator GORE. When was it established?

Mr. THIBAUT. Four years ago. You cannot make those investments if the source of data and the price of data is uncertain. And I think that is the challenge—

Senator GORE. So, you need clarity of the kind you think legislation can establish, where these ongoing negotiations may not.

Mr. THIBAUT. We have to look at the track record of the negotiators and I think the public is in this instance well served by explicit legislation.

Senator GORE. What is the approximate amount of revenue generated annually by your industry, this value-added industry?

Mr. THIBAUT. I took a shot at that in my opening remarks, and there have been many studies which suggest that it is somewhere between 5 and 20 times the data cost. If we assume that the data costs are as reported, some \$60 million for SPOT and Landsat, you are looking at a very substantial economic activity, we think on the order of \$200 to \$300 million and those figures support our experience in terms of the multipliers.

Senator GORE. All right. Dr. Jensen, you argue emphatically that the United States has lost its leadership in satellite land remote sensing technology and that it was this 1984 act which led to it, that we were the leaders up until that point and then we began to lose the lead.

Was it because EOSAT, as the Landsat contractor did not listen to the needs of the user community? Is that what you are saying, because most times we hear that the exact opposite is to be expected: If you privatize something, you are going to get more responsiveness to the private sector and to the people than you would get from Government.

But you are saying that that is in fact what happened in this case?

Dr. JENSEN. Basically, through the 1970's, we had a tremendous groundswell of development of the remote sensing technology. And NASA was heavily involved with regional application centers. Every State in the union became online and developed centers of excellence in remote sensing.

With the commercialization that took place, basically NASA washed their hands and turned it over to EOSAT. NASA has done a very good job concentrating on the EOS program. They have excellent sensors, excellent science and the Landsat program needs to dovetail into it.

In the early years, EOSAT had some really unusual policies. For instance, even in the testimony to be given later today, Silvestrini says, they had an \$800 data acquisition charge in addition to a \$3,300 data cost. I mean, there were things there that you just would not believe when you saw them.

in the beginning, EOSAT dropped the cost a little bit, but it has escalated up now to \$4,400. So, the price keeps going up.

My heart goes out to the EOSAT sales representatives. When I talk with these people, I find they are excellent scientists. It is like working for General Motors and creating a car in 1982 and then not improving it until it is going to be 1993 and I am selling that same car.

Now, in 1993, we get a new tire on the car, a new panchromatic band. And that has got to service us until 1998. My heart goes out to the marketing staff of the company because they have been able to do as well as they have done with the resources that they have had.

My own feeling is that in the last year, I have seen more movement toward making interactions with State agencies. For instance, I think later today you will hear testimony that they now have a statewide data program for State agencies. We are considering it in South Carolina. I know Florida is. There are a certain number that have already signed on. You could not talk to them about this at all in the first years of development.

Now we are going to hear today that EOSAT is willing to propose that they hold aside a certain amount of their revenues for actual grant research, for people to do research using their data. This was absolutely unheard of in the early days and might have been of great value.

The worst and most devastating problem is the fact that our technology has just stayed stagnant. So, it is a combination of factors here and I think some of them maybe they did not have control of. All I know is in 1993, when I weigh the alternatives for a watershed analysis or an urban analysis, I am going to have to buy SPOT data. It will fulfill the need of the applications that I have at the local, regional and State level. Separate and distinct from

EOS sensors, we just do not have land remote sensing systems that will satisfy most of these needs. We could have had them by now and we do not.

Senator GORE. Now there is a certain value, is there not, to the continuity of the Landsat imagery that cannot be replaced by having a data series that begins with an early Landsat series and then picks up with SPOT or with some other imaging system?

Dr. JENSEN. Well, I find that everybody talks about data continuity as if we can never change the sensor systems. That is a tremendous fallacy. If Landsat were to not function anymore, we still have the SPOT data stream. That is very valuable. We can register that with previous images and do change detection.

We have digital image processing techniques that will allow us to compare 20-by-20 meter data with 30-by-30 meter data. This is not something that is impossible.

So, for us to change to a new sensor system at some point does not preclude continuity at all. In fact, we have got to do it. We moved from 80 meters in MSS to 30 meters in TM. No one complained.

Senator GORE. There have already been changes.

Dr. JENSEN. Yes, we have already seen change. We are now going to go from 30 meter multispectral to 15 meters for panchromatic—change in sensor system design is part of the process and that does not preclude continuity at all.

Sometimes I hear this argument, "We need the continuity, do not change the sensor system." To my way of thinking, that is ridiculous.

Senator GORE. I have some other questions, but I am going to hold them until a brief second round. I want to recognize Senator Pressler now.

Senator PRESSLER. Thank you, Mr. Chairman. Following up on what Mr. Blackwelder said about the support, I have here letters from the Governor of Vermont, a letter signed by the National Governors Association, signed by John Ashcroft, Governor of Missouri and Roy Romer, Governor of Colorado, and several other letters of support.

I do not know about the cost of printing these, but I think it could be made available to whatever the general—

Senator GORE. I think that we ought to make those a part of the record, if you wish. Without objection, we will receive them for that consideration.

[The information referred to follows:]

LETTER FROM GOV. GEORGE A. SINNER, CHAIRMAN, AND GOV. NORMAN H. BANGERTER, VICE CHAIRMAN, COMMITTEE ON ENERGY AND ENVIRONMENT, NATIONAL GOVERNORS ASSOCIATION

APRIL 23, 1992.

The Honorable LARRY PRESSLER,
U.S. Senate,
Washington, DC 20510-4102

DEAR SENATOR PRESSLER: The Governors strongly support provisions of S. 2297 that make Landsat imagery available to the public sector, including state and local governments, at the marginal cost of reproduction. For the past decade, high commercial prices, about \$4500 per image, strictly limited the use of Landsat data in the public sector. Marginal cost pricing would reduce the cost of data to \$500-\$600 per image, vastly increasing the potential for its use by state and local governments.

The Governors support marginal cost pricing for two important reasons. First, Landsat imagery enhances the ability of state and local governments to manage natural resources and deliver quality public services. Landsat data has applications to a multitude of state and local government functions, for example, watershed and air quality monitoring, flood and fire hazard evaluation, timber and wildlife management, geological mapping, and waste incinerator siting. States were enthusiastic Landsat users in the 1970s, when data was available at a relatively low cost.

Second, since the development of Landsat—including R&D, and satellite construction, launch and operation—is funded largely by federal taxpayers, sale of the data to the public sector at commercial rates amounts to an additional tariff that state and local governments can ill afford to pay. We understand that federal taxpayers have invested a total of over \$2.0 billion dollars in Landsat, not including funds spent on the purchase of data. The application of market principles can be as valid in the public sector as in the private sector. However, we believe that differential treatment of government entities is justified in the case of Landsat, because the public has in effect already paid to develop this data source.

Thank you for your attention to this issue. Please feel free to contact us if we can be of any assistance.

Sincerely,

GOV. GEORGE A. SINNER,
Chairman, Committee on Energy and Environment.

GOV. NORMAN H. BANGERTER,
Vice Chairman, Committee on Energy and Environment.

LETTER FROM GOV. HOWARD DEAN, STATE OF VERMONT

MAY 4, 1992.

The Honorable LARRY PRESSLER,
U.S. Senate,
Washington, DC 20510-4101

DEAR SENATOR PRESSLER: I am writing to express my enthusiastic support for S. 2297, the "Landsat Remote Sensing Policy Act of 1992," which I understand would provide Landsat data to any interested party, including state and local governments, at the marginal cost of reproduction.

Since Landsat imagery became marketed and sold by the private sector in the mid 1980's, this important data has been available only at high commercial prices (about \$5,000 per image). It is my understanding that S. 2297 would bring down the cost of this imagery to levels affordable to state and local governments whose constituent taxpayers have consistently funded this technology.

As you know, the changeover to privatization has kept this information from being used where it belongs—in the public domain.

The need for this data in Vermont, one of the nation's richest states in terms of natural resources, is varied and widespread. Landsat has applications in our state in the areas of forest management, geologic mapping, groundwater analysis, acid rain monitoring, analysis of critical wildlife habitat, wetlands mapping, and land use planning, to name only a few. The data has been used in Vermont and throughout New England to inventory forest degradation. The Environmental Protection Agency (EPA) has also used the Landsat technology to map wetlands in Vermont and Canada. Once affordable, Landsat data could be converted for use with the state's Geographic Information System.

The release of unenhanced Landsat data to the public that would promote commercialization in the area of software and computer hardware is a sound idea. Demand for interpretation of this data through new and innovative computer programs will likely become a burgeoning industry, thus helping to legitimize the commercialization of space-generated technology.

I am confident that the passage of legislation that returns this technology to the public sector will result in improved environmental management practices in each state as well as in the entire country.

Sincerely,

HOWARD DEAN, M.D.,
Governor.

Senator PRESSLER. And there are things from the University of Nebraska, Land Resources Conservation Commission; State of

South Carolina has a letter of endorsement. So, in other words, there is a growing number of people endorsing this legislation.

Let me just ask a very general question to Charlotte Black Elk, first of all. And I thank her very much, because her statement sort of put it into practical effect. You, as an Indian tribe member, asked about some information and you were told it cost \$200,000 or \$300,000 and you did not really know what you would be getting or what you would be doing with it. And you made the very wise suggestion that somehow or other there may be centers or something, there could be a whole resource of things in these pictures for different—whether it be studying the environment or doing different things, we really do not know the full potential of these pictures.

We now have, in South Dakota, at the EROS Data Center, we have a NASA flag flying and we have a U.N. flag flying. I am proud to say that the director for the environment for the U.N. was in Sioux Falls recently.

But I have a dream, so to speak, of a supercomputer there, which is a very realistic thing, hooked up nationwide, thanks to Senator Gore's legislation on that, but which people could access through fiber optics cable. Not only the pictures, but some index, some guide as to how to use them.

But all of that being said, aside from lowering the price, if Landsat data were less expensive today, how would you envisage tribes utilizing that data?

Ms. BLACK ELK. Well, let me give you an example that we are dealing with. We have the bombing area with all of the aerial gunnery range in the Badlands. We are having sinkholes out there. Unless we go and hire a small airplane or a helicopter and fly over it, we cannot go see one sinkhole because we cannot identify all of the spent munitions. It is dangerous for me to send my rangers out there in a vehicle. They might blow up. We have had our mountain sheep that we paid a tremendous amount of money to capture and restock blow up when they stepped on these bombs.

If we were able to sit down and look at that area, I also envisioned—I am, I guess, a frustrated educator—seeing elementary schoolchildren. In South Dakota this year we had a linkup using television cameras with the State legislature linking up the elementary school at Hill City, the third grade classroom. And third graders sitting there, in their classroom, taking part in the legislature. I see that kind of activity with remote sensing, being able to happen where our universities can tie into elementary schools.

I do not think that is unrealistic. We have the technology. We do not have the policy right now. We seem to not have the will to do that. I see there where we can look at instream water flows. We are looking at a whole array of environmental protection.

We manage three very large buffalo herds. And we are attempting to market the only wild herd which is raised with no additives, no chemicals. And we think that this is a market that we can establish. We have to go out and physically walk our buffalo pastures or go out there on horseback and then that diminishes this being a wild herd.

And so there is a whole array of areas. Where is the water? Where do we build our next houses? We have the same concerns

that counties have and like many counties, particularly in rural States, we do not have the money to pay thousands and thousands of dollars to get data that we cannot understand. We need to be able to have training.

I guess if I go and get training on how to use a calculator, I am not putting any private business out of commission. It enhances that private business that I have skills to use technology. And so I really see it as an area that can be beneficial to everybody, to the schoolchildren, to the planners, to private industry and to the Federal Government. If you have an informed public, I think they can help in that agenda of cleaning the environment.

Senator PRESSLER. Thank you. You have eloquently stated some of the practical uses. I know the National Association of Counties has told me that they have some of the same objectives. But I think your eloquence here today is very, in terms of what the practical applications could be, just the beginning of them, is very useful to us.

For Mr. Thibault, I have some questions. I know that you have worked for EOSAT. I know you run, it has already been pointed out, you run a value-added company, which purchases Landsat data.

Just tell us, what kind of customers do you service?

Mr. THIBAUT. It is interesting. Our business has changed over the last 20 years. Initially, we were principally a Government research contractor. But by the mid-1970's, our success in exploiting ERTS 1, Landsat 1, Landsat 2 data, identified some commercial areas and our business began to grow into the areas of mineral and petroleum exploration, agricultural forecasting and generally, land management which involves environmental concerns, both of industry and in Government.

Much of our work has been abroad in areas of the world that are not well known. And where this technology for inventorying and understanding resources is an excellent and cost effective one.

By 1990, our business was 92 percent non-Federal, our clients largely in the resource business and foreign organizations.

We see the future as one of more effective public use of the data if the policy of making these data available to the organizations represented in the legislation comes to pass.

Senator PRESSLER. Now, what is the relative size of the value-added remote sensing industry in the United States in comparison to the annual sales volume at EOSAT? How many people are employed by each industry?

Mr. THIBAUT. I would guess that we are talking somewhere on the order of 10 to 15 times as many people actually being employed in the exploitation of the Landsat data.

Senator PRESSLER. Now, the bill S. 2297 envisages a situation where the system operator, either Government or commercial, would produce a raw data product and make it available to anyone at relatively low cost. The value-added industry could then produce user products and market them competitively.

Now, what are the advantages and disadvantages of this approach, first of all? And second of all, do you feel granting a contractor exclusive marketing rights to Landsat data hurts competition among value-added firms?

Mr. THIBAUT. Let me answer the second question first. I think that the provision of S. 2297 which assures nonexclusive marketing rights is an appropriate one. And I think we simply have to look at the precedent of the census data and weather data.

What we have seen is that the commercial sector, having unrestricted access to these data, have produced many enhanced and added value products and services and have grown in industry, not depending on the Government for support.

With respect to the former question, I think that the concerns that I raised earlier about investment and commitments are appropriate. For this commercial enterprise to grow, there must be a higher level of confidence than exists.

I would like to say one thing and I would like to at least be one to defend EOSAT. I think that there has been much criticism of their stewardship of the Landsat program since 1985. I think some of that is misplaced, perhaps most of it is. The law, which they were forced to operate under, was our law. It mandated commercialization. That was our mistake. It was not EOSAT's. The policies that they promulgated were those which they believed, and I think even on Monday morning looked appropriate to making a commercial success of that enterprise and to funding Landsat 7 and beyond. The simple truth is that our assumptions were incorrect and that is not EOSAT's fault.

Senator PRESSLER. Your point is they are operating under the policies that were set up by the Government and they took advantage of the opportunity to do so.

Now, the National Space Policy Directive 5 states the U.S. Government will promote and not preclude private sector commercial opportunities in Landsat-type remote sensing. We have seen over the past several years at commercial Landsat operations a situation where research had been denied access to essential data because of the high cost of those data.

Do you feel the greater competition resulting from our proposed policy of not granting exclusive marketing rights to a single contractor meets the space policy goal of commercial involvement?

Mr. THIBAUT. Yes. I think that what we have seen is in those areas where access has been opened up in other data sets that there is great genius abroad in the land. And access to technology and to data produces results that we do not even dream of. And the economy and the society benefit from that access.

Senator PRESSLER. I think that was the point Ms. Black Elk also made: is that we do not even know what the uses of this might be.

Would you agree that nondiscriminatory pricing will encourage more commercial use of Landsat data?

Mr. THIBAUT. Yes. And let me say that I think that, inadvertently, the 1984 bill has a discriminatory pricing aspect and we have been hearing about it all morning. One discriminates against people who cannot afford to buy data and that is a problem with which a large community of users has had to deal. I think that the commercial activity will grow dramatically if the data become more reasonably priced. There will be more entrants into the value-added market and we will benefit from that.

Senator PRESSLER. Now, we have heard earlier that the administration is asking that we stay silent on discriminatory pricing and

data access. What would be the practical effects of not rigorously defining data policy?

Mr. THIBAUT. Well, I think that I would rather put this matter in the hands of the Congress, which is, I believe, more likely to respond to the needs of a broad sector of the country. I am much concerned that left to negotiation, that the administrators of the program and the Landsat contractor will arrive at an agreement which is not in the interests of all parties.

Senator PRESSLER. Now, my bill mandates that Landsat data be available at marginal cost. Others, I believe, the House maybe, suggest a multitiered approach, where we would required Landsat data to be made available to the Government and global change researchers at the cost of fulfilling user requests. I believe this would allow lawyers to successfully argue that this definition covers all costs, including satellite operation costs, maybe not just lawyers, but other people who would be doing this.

What would be the impact of this definition on data price for the Government? And in your testimony, you say multitiered pricing fails on economic and operational grounds. Could you explain this?

Mr. THIBAUT. Well, I think the operational grounds are clear. One has to put in place some organization to police the non-commercial data. And as a discriminated against consumer, we would use every legal means to assure that data are properly used. I earlier raised the question of the international distribution of data.

If data are distributed to the Japanese Government under the EOS program, you can be assured that those data will be available to the Japanese national oil company and in fact, you will see competition with U.S. companies who have paid a higher price for Landsat data.

I think that there simply is no means of enforcement and H.R. 3614 provides advantages to foreign competition. We disadvantage American corporations who have, with the American taxpayers, paid the cost of these systems.

Senator PRESSLER. S. 2297 provides for Government ownership of all enhanced data acquired by the Landsat system and no exclusive marketing rights are extended to any contractor. If this section were made law, how would this affect NASA's negotiations with EOSAT?

Mr. THIBAUT. Well, we heard a lot of discussion about the Landsat 6 contract and this clearly is a matter perhaps best addressed by lawyers, but it seems to me, as Dr. Fisk testified, that if he can negotiate with EOSAT for a price for his constituency that he can negotiate with EOSAT for a single price for all constituencies, and that means clearly that some settlement has to be reached with EOSAT on its contract.

I would say, however, that it is entirely inappropriate for a Government buyout of the EOSAT contract to be funded by high-priced data to a small number of users who account for less than 10 percent of total data use.

Senator PRESSLER. Now, in your testimony, and following along on that statement you just made, you state the pending House bill encourages the establishment of a Government-sanctioned, vertical monopoly which will hurt consumers, the value-added industry,

and the Government. How would that vertical monopoly come about?

Mr. THIBAUT. Well, as you will note, H.R. 3614 suggests that one of the ways that EOSAT can be compensated for the bankrupt policy which H.R. 3614 promulgates is to allow them to go into the value-added business. In fact, the existing bill allows that as well, and it provides protections as does the proposed legislation, but we think those protections are inadequate. EOSAT has extraordinary access to information on the consumers of the data. They have a marketing staff in place which far outsizes any of their competitors. They have control of when and which data will be acquired, so what we are saying is that the organization that acquires the data, that distributes the data, may also be a primary user of the data for value-added services. That is lousy policy.

Senator PRESSLER. I notice in your testimony the effect of multitiered pricing would result in the United States providing commercial intelligence to our international competitors at one-tenth the price the American companies would pay. Could you explain that statement?

Mr. THIBAUT. I am making an assumption that the marginal cost or the negotiated cost with NASA and the EOS users is somewhere around one-tenth of the current Landsat price.

The reason that the data which have commercial intelligence value will be provided to organizations competing with U.S. companies is because only in the United States and perhaps in the U.K. is there a distinction between what is Government information and what is private information, and in fact those Landsat data will flow—with no reproduction restrictions on the data.

The Chinese Government will make those data available to the Chinese National Oil Co., you can be sure, and that represents unfair competition, well-funded by the United States Government.

Senator PRESSLER. I am going to ask the rest of my questions to you for the record. In the interests of time I just have one question for Dr. Jensen. I notice in your testimony you charted the results of a questionnaire. Dr. Jensen, you have mentioned that. What is the bottom line of the results of that?

Dr. JENSEN. Well, there are a number of questions within the questionnaire. I only extracted three, and I put those in the document as figures 1, 2, and 3. They are from a study by Dr. John Estes and D. Jones at the University of California, Santa Barbara that was recently completed. They presented the results in Switzerland and it has been published.

Dr. Estes is one of the premier remote sensing people in the United States. He is one of the codirectors of the NSF-funded National Center for Geographic Information and Analysis. They get about \$1 million a year to do this type of coordination worldwide. He instructed this questionnaire to be sent out—299 geography departments received it, 167 geography departments responded to it with the person in charge at each place being the remote sensing person.

As I said before, 77 percent felt commercialization had impacted negatively or very negatively the remote sensing research nationwide; 74 percent that it had negatively or very negatively impacted remote sensing education in the United States; and 86 percent,

what I consider to be an overwhelming amount, when asked how strongly you would support the Federal Government taking over the operation of Landsat system, 86 percent registered either support or very strong support. Only 4 percent said that they were opposed. So, as I said before, there is a tremendous groundswell, as recorded by this instrument.

Now, Dr. Estes is in the process of inventorying foresters and other disciplines to try to get a broader cross-section of America. But, this is still very important information. There is a real feeling of not having the adequate technology out there to do the job that we as academics do.

We interact with our State agencies. In fact, in my State the people running the State agencies, the land resources, the water resources, the coastal council, those are our students, after 5 or 6 years, that are in charge of those agencies, and we train them, and then when it comes time to doing the job, we do not have the resources, the satellite resources to do the job, and so it does not surprise me that we find this type of, kind of pent-up frustration echoed in this questionnaire.

I have the complete Estes and Jones paper. I could submit that as part of the record, if you like. I only abstracted three figures from it.

Senator PRESSLER. Yes, if you would submit that, and I have two final technical questions for Dr. Blackwelder there and then the rest of my questions will go into the record.

Dr. Blackwelder, other than EOSAT, can you think of any other group in America that opposes our nondiscriminatory access and marginal cost provisions?

Dr. BLACKWELDER. I know of none.

Senator PRESSLER. The OMB Circular A-130, you are obviously familiar with that. The proposed regulations on how to deal with the federally procured data now, what will be the impact of deleting the section within S. 2297 in my bill which specifies that the cost of the Landsat data not exceed the marginal cost of filling a specific user request and allowing NASA to negotiate with EOSAT a policy that conforms with OMB Circular A-130?

Dr. BLACKWELDER. I think it is too risky a bet. You have got a long period of public comments. You have no assurance what final form those regulations will take. We fully support your taking decisive action and putting this policy in law, and let it go from there.

Senator PRESSLER. Thank you very much.

Mr. Chairman, I do have some additional questions for the record.

Senator GORE. Let me just ask one other question. Dr. Henderson, you know that the NASA/DOD management plan suggests that Landsat 7 will largely be a copy of Landsat 6 with a small number of sensor technology enhancements possible. Briefly, how will this meet the needs of your member companies, and are there specific technology enhancements that you feel are needed by your member companies to make Landsat 7 competitive with the international remote sensing systems?

Dr. HENDERSON. First let me say, Senator, that I think it is important to keep in mind from our point of view we use all the systems because they are our original requirements, which we all per-

haps would have liked to have all seen built in the United States, but were not for a variety of reasons.

We want to see access to a good radar coverage of the world.

The Japanese have built one, but they have made no statement about disseminating that commercial. We have asked EOSAT if they could negotiate with the Japanese to provide that radar. That happens to give the Japanese a lot of advantage in the Southeast Asian area for cloud-covered areas, so radar is an important thing—global radar coverage.

We would have liked to have seen, of course, SEASTAR built that is important to offshore operations. We would like to see something like the HIRIS system that was proposed for EOS and some of the other EOS sensors, also, but HIRIS and aerospectral band data is extremely important to spectral geology and spectral agriculture and spectral everything, and those systems ought to be encouraged. Right now, the only one that is building that is going to be a Japanese system to fly on an EOS system if they share the data.

Senator GORE. Now, you have expressed confidence that Landsat will ultimately serve the needs of Government researchers at DOD and NASA, but that you remain unconvinced that the needs of commercial users will be met. Have you been reassured on that point by what you heard NASA say today?

Dr. HENDERSON. No.

Senator GORE. I am going to have other questions for the record also, for all of our witnesses.

I would like to thank all of you for taking the time to help us find our way through this maze of issues. These are excellent statements, and thank you all very much.

Excuse me, Dr. Henderson.

Dr. HENDERSON. Could I just finish one thing to amplify a question you had of Dr. Jensen? In terms of losing the competitive edge, one of the reasons is that all of the requirements of the various sectors of the country were not in the design planning.

As I stated before, the Japanese geology satellite was designed by consensus across the various groups within Japan, and it was decided that was in their national interest to have that and include it in the resource base as important.

The second major thing that again is not necessarily EOSAT's fault, and I emphasize I agree with David Thibault in that context, the legislation caused NASA to no longer want to deal with our industry. It is easier for us to have a cooperative agreement with Japan or ESA to do applications demonstrations technology programs important to the education of what this can do.

The third thing is neither system right now is incorporating or supporting education. We need more Geosat demonstrations to better understand how to use this technology.

Senator GORE. That, too, is a good point, and I, too, wanted to identify with the earlier comments of Mr. Thibault on where the blame lies. That game is often played here in Washington.

The blame lies with the legislation and with the recommendations of the President and the actions of the Congress in adopting those recommendations. The assumptions were simply wrong. We now see that, and it is of little point to blame those who operated

within the set of incentives that were established by those ground rules, and in that legislation.

Anyway, thank you all very much. We appreciate it.

Our final witness is Mr. Arturo Silvestrini, the President and Chief Executive Officer of the Earth Observation Satellite Co., based in Lanham, MD. We are glad to have you here, Mr. Silvestrini. Thank you so much for sitting through a long series of statements not all of which can have been to your liking. But we are happy to hear, as Paul Harvey says, the rest of the story, so please proceed with your perspective on these issues.

STATEMENT OF DR. ARTURO SILVESTRINI, PRESIDENT AND CHIEF EXECUTIVE OFFICER, EARTH OBSERVATION SATELLITE CO.

Dr. SILVESTRINI. You are going to hear the rest of the story, you are right. Thank you, Mr. Chairman and Senator. I actually thank you not like everybody else, but I thank you a lot, because you gave me the opportunity to clarify a few points either today or in writing later on, and that I think you need to know.

I would first like to introduce myself, as I have been with EOSAT in this position only since November last year. However, I have been associated with the program for over 20 years in my previous professional life. My people were processing ERTS 1 data, and actually we were the first commercial contractor to operate the first Landsat 4 and 5 satellites, so I know a few things about this.

All of the things I heard today, or most of them, negative about EOSAT were the ones that I had last year when I heard the first phone call asking me to join EOSAT after my retirement. Those were the reasons I declined to join EOSAT, but also they were so bad that they were the ones who forced me to analyze the facts better.

My conclusion in November was to join EOSAT for two reasons: one, to help the Government to do this program; two, to see if EOSAT could be put back in shape to do what it was supposed to do originally. Please check my relations with my previous work with the Government. My relation is to work with the Government and the Congress like a partner and not as a contractor. I want to do the same thing now. That is what I am doing.

Most of the statements that I heard today, believe it or not, I share. Personally, I agree that we should have better technology in the future, but do not forget, Landsat 6 was cast in concrete about 6 years ago, too late to change. Continuity, I envision continuity in a different way. Wherever there is a researcher on the ground you need continuity from one satellite to another, and each one of them should add something new so the next one will be a continuity of the new instead of the old. This is what we should attempt to do.

Now we are too late again. If we do not have something that the people on the ground can use the way that they used to, Landsat continuity is going to be lost. The gap will occur for the researchers. It is what they have that counts, and not what is up there, really, in my opinion, and I was a scientist in my early days, 35 years ago.

There are a few things that I do not agree with today—the precipitous decline of the sales of the data based upon the numbers.

Please remember one thing, that in the early days we were selling pictures, one scene or digital data is more than 200-and-some pictures. Nobody buys pictures any more, so the decline in numbers that you see is probably due to an improvement in technology and not to a lack of interest.

We have not reacted to the legislation. I wish I had seen yours before. My first talk to NASA was before I joined EOSAT. If Fisk had been here now—I think I saw Shelby Tilford there. I went there to counsel with them to see what they thought was necessary, to see if they would help me in turning around EOSAT and make it more useful for the research and the scientists. This is when we started talking. There was no law around that I knew of.

The movement that EOSAT is doing is sincere. Where does it come from? Of course, we did not go your way. Either way, we will do something different. I agree with everybody that the legislation was not appropriate, and it is true that EOSAT has been operating under a tremendous pressure from that legislation, no question about that.

I agree with the fact that the scientists were paying too much, but that we had to cover. In effect, EOSAT cut the prices. There were some scientists that were getting data for much less than everybody else, but that was because NASA was paying NOAA in terms of the TDRS time, so it was subsidized. Our effort that we are doing now, which will start even before we sign any agreement, by the way, is yes, to provide data at less price. It does not look like a good deal, but you have not heard the rest of the story. The rest of the story is that that 50 percent we get we reinvest in grants. Why do we do that?

Senator GORE. Excuse me, you reinvest in grants?

Dr. SILVESTRI. Yes, to researchers.

Senator GORE. Are you making grants now?

Dr. SILVESTRI. No, we are negotiating that. My proposal was on the floor with Congressman Brown in November. We are still negotiating, but we will. We are progressing.

The fact is this: We are now ready to operate two satellites plus Landsat 6 at no cost to the taxpayer. We are now negotiating with NASA things that we proposed a long time ago. Why we did not do it before, I do not know and I do not care. Actually, I really do not care. My intention is to make it work now. It will, with your help.

My recommendation at this point—and I want to just respond to your questions after that because you have got my testimony anyway. The summary of my testimony is, No. 1, we do need a new satellite. Please do whatever is necessary with this legislation or the other to make the changes necessary from Commerce to NASA and DOD so that they can go ahead and build the satellite or we are going to be late again. That is the first recommendation.

The second recommendation is—and by the way, we are not building that satellite as EOSAT, OK. Whoever does it, we need to do it fast. The second recommendation is, please, Senator Pressler, let NASA negotiate with us. They are going to get a good deal. They are getting a good deal for the researchers. This will open the door for us to continue to pay for the operation of 4, 5, and 6 and

for whatever is necessary while they are alive at no cost to the taxpayer whatsoever. This is a good deal, too.

The third recommendation is the reason why instead of zero cost to the researchers, we said 50 percent: we are investing grants for research because the major problem that the research had in the seventies and eighties was not the price of the satellite data, it was the lack of application grants from the Government which terminated completely and killed every research.

If we put money in the research after we get it from the Government or whoever, that is the only way to stimulate that research, and so if there is any money in the budget any place, make it in such a way that it goes back into grants for research and new technology for advancement. This is the recommendation of Arturo Silvestrini, which by definition is the recommendation of EOSAT.

Thank you.

[The prepared statement of Dr. Silvestrini follows:]

PREPARED STATEMENT OF DR. ARTURO SILVESTRINI

I would like to begin by expressing my thanks for the subcommittee's interest in the Landsat program and commercialization. The last Senate oversight hearing on the Landsat program was at the time of the original passage of the Landsat Commercialization Act of 1984. Since then increasing concerns have been raised about our collective failure to fully utilize remote sensing data to study changes in the global environment and to guide policies that would halt or reverse dangerous trends resulting from human activities. Combined with problems and delays in the commercialization process itself, these concerns have caused some to question the viability and value of commercialization. EOSAT appreciates the opportunity to appear before you to address these concerns in light of the current status of the commercialization effort, and to make suggestions for revisions in the legal charter for commercial land remote sensing.

I would like to stress that EOSAT is here today as the government's partner in the Landsat program, a status we have enjoyed since 1985 when we were chosen to work with the government to build a dynamic land remote sensing industry in the United States. Like commercialization itself, this relationship has not always been easy. Commitments were not always honored by the U.S. Government, and EOSAT at times fell back on a aggressive defense of its prerogatives under the 1984 Landsat Commercialization Act. The spirit of partnership necessary for Landsat commercialization to be a success was eroded. Yet these problems and delays by themselves do not justify abandoning the public/private partnership. Rather they highlight the need for regular dialog among all parties to dispel mutual misperceptions and establish a common understanding of what has actually transpired since commercialization began, how that relates to trends that were established much earlier in the Landsat program, and how Landsat can contribute to efforts to preserve the global environment. Dialog is the only way to ensure that proposed changes in the program actually address the real causes of the problems we are seeking to solve.

EOSAT believes that, with some fine-tuning, the 1984 Landsat Commercialization Act, as amended in 1987, provides us with the flexibility that is needed to carry out this dialog and implement needed changes. We hope that the ongoing EOSAT/NASA dialog, which is producing positive results for the collection and dissemination of global change data and the funding of research, will serve as a model for wider discussions to address other problem areas. For this reason, we would like to echo the words of the 1987 amendment to the commercialization act in which Congress stated that "it is in the national interest of the United States that the involved Federal agencies and the private sector remain flexible in carrying out their respective responsibilities under that Act." Although EOSAT sees the necessity for legislation to authorize and fund Landsat 7 construction and to transfer oversight to agencies more directly involved in utilizing Landsat data, as well as to maintain a flexible data policy and fund research activities, other major changes in the Landsat program would be misguided at this point. With Landsat 6 we are about to begin the central phase of the commercialization process established by the 1984 Landsat Commercialization Act. Major changes in commercialization policy now would cost taxpayers millions of dollars—just as they are about to reap the benefit of the in-

vestments made by both the public and private sectors during the preliminary phases of commercialization. In addition, such changes would deprive the nation of its opportunity to assess the viability of commercial land remote sensing.

STATUS REPORT ON THE LANDSAT PROGRAM

The commercialization experiment has encountered problems, but significant progress has been made in commercializing remote sensing technology, even though we are only just now reaching its central phase—the operation of a commercially oriented satellite, Landsat 6. Unfortunately, our progress has often been overshadowed by the unnecessary and damaging debate in recent years that was pushed by erroneous conclusions based on superficial and incomplete analysis of what has transpired since commercialization began. The resulting polarization of positions has not fostered the good working relationship between the public and private sector necessary if the United States is to remain the leader in remote sensing. Fortunately, EOSAT is finding that the climate is changing. This week, for example, reports that a new study commissioned by two NASA Centers for Commercial Development of Space foresees a booming commercial market for the remote sensing industry, and calls into serious question the pessimistic view of earlier studies that are the foundation of much of the criticism of Landsat commercialization. Although I have yet to see the new study, I am aware of what EOSAT has achieved and where it stands today. I would like to describe these achievements to you.

The end of the federal operating subsidy on 30 September 1992. By expanding the market base, increasing sales, and reducing operating costs, EOSAT has closed the gap between sales revenues and operating costs. As a government program, Landsat never came close to meeting this objective, which has been a central goal of commercialization. Under the commercialization timetable, this goal was to be achieved by the time that Landsat 6 was in operation. We will reach the goal early. The final months of Landsat 4 and 5 operations and the operation of Landsat 6 will cost the taxpayer nothing, compared to the nearly \$20 million a year that the government has been paying for the operation of Landsats 4 and 5 and the even higher sums suggested in some of the latest plans under consideration for Landsat 7.

Private investments in ground and space segments of Landsat system. EOSAT has invested more than \$12 million in order to develop a robust ground segment for the Landsat system. As part of these investments, we have built a new ground receiving station in Norman, Oklahoma, and have developed and installed new processing equipment. The processing equipment is already on line, and the new ground station begins operation this month. In addition, EOSAT contributed \$10.8 million towards the construction of Landsat 6. These private sector contributions have directly reduced federal expenditures for Landsat 6 and improved service for our customers. Furthermore, additional investments are being considered in order to extend the U.S. sphere of influence in commercial remote sensing.

Creation of an international marketing network that has increased the user base for Landsat data. Prior to commercialization, the trend in Landsat sales was towards ever increasing reliance on sales to federal agencies. Government purchases do remain an important part of the market, especially in 1990 and 1991 when events in the Persian Gulf pushed military purchases. But even in those years, purchases in support of national security concerns were less than 25 percent of sales. More importantly, the trend of the early 1980s towards ever greater reliance on federal sales has been reversed. Today commercial sales in the United States and abroad account for nearly 50 percent of EOSAT's sales revenues. In building this commercial network, EOSAT received no federal support, but has relied exclusively on its own sales revenues.

Improvements and new efficiencies in ground operations. Since 1985 the federal appropriation for Landsat operations has fallen 50 percent in real terms. This cut was driven by budget austerity measures implemented by the Administration and Congress. In order to protect our commercial interest in Landsat, EOSAT was compelled to find more efficient ways to operate Landsats 4 and 5 with the limited funds available. We had to maximize output, while minimizing the impact on users. Our success in achieving these objectives was facilitated by the equipment we designed and built for Landsat 6 operations, but were able to bring into operation ahead of schedule. Government agencies are not pushed by the market forces that drove EOSAT to introduce these changes, and it was to gain this type of market-driven efficiencies that Landsat commercialization was begun.

Lower digital data prices made possible by a commercial pricing structure. Part of EOSAT's commercialization mandate was to explore commercial pricing of data. In the years prior to commercialization, the government was pursuing a cost-recovery approach, and prices were escalating rapidly. In 1985, the last year in which the

government operated Landsat, users paid \$4,400 for a digital Thematic Mapper (TM) scene, plus a \$800 surcharge if the scene was a new acquisition rather than data from the archive. Given the federal budget cuts and the government-wide effort to have users pay for the government programs that benefit them, the upward spiral probably would have continued had commercialization not taken place. EOSAT, however, recognized that this cost-recovery approach could not work in the face of competition from the French satellite system, SPOT. A loyal customer base had to be built through competitive prices and good service. Thus after its contract was signed, EOSAT dropped the price to \$3,300 and soon eliminated the surcharge for new acquisitions. Since that time, prices have risen, but adjusted for inflation the price of a TM digital scene is still 21 percent lower today than in 1985—and no surcharge is imposed for new acquisitions. From a competitive viewpoint, allow me to note that SPOT's price is five to nine times higher than EOSAT's.

Progress on the researcher access problem through public/private cooperation. The precipitous drop in sales to academia in the late 1970s and early 1980s, the low level of Landsat utilization by researchers in the mid-1980s before commercialization began, and the continued low level after commercialization demonstrates that neither the public sector nor the private sector has been able to address the problem of researcher access on its own. EOSAT is eager to work with appropriate government agencies, especially NASA, to increase data availability to researchers. To get the dialog moving on a research data policy for the Landsat 6 and 7 era, we have proposed to NASA an interim plan to be followed for the remainder of fiscal year 1992:

- EOSAT will dedicate up to 25 percent of our productive capacity to the collection of research data selected by NASA.
- NASA will pay 50 percent of the list price for this data set and will distribute data to researchers for noncommercial use.
- EOSAT will use all revenues from these NASA purchases to make grants to researchers.

I am happy to report that NASA has responded favorably to this proposal, and has itself proposed some modifications to strengthen the grant activity. EOSAT and NASA are meeting weekly to work out the details.

Evolution of a digitally based market. In the last ten years user preference for Landsat data has shifted decisively in favor of digital data. The amount of data contained in a TM scene compared to an MSS scene has made photographic analysis less adequate, while technological advances and falling prices in computer hardware and software have put digital analysis within the reach of even low budget users. It is important to note this change because it has significantly restructured the market for Landsat data. When the market is driven by photographic analysis, the total number of photographs sold is extremely high because the analyst needs many photographs made from the data contained in one Landsat scene. In contrast, the digital analyst needs but one digital scene. Thus, while today's sale of digital data appears low in comparison to the sales volume of photographs a decade ago, this does not reflect a collapse in the market, but a technological revolution that has changed how the data are used.

The pending launch of a commercially oriented satellite, Landsat 6. The launch of Landsat 6 has been delayed many years because of the loss of its original intended launch vehicle (the space shuttle), erratic government funding for the Landsat program, and delays in the construction itself. We anticipate delivering the satellite to the government for launch late this fall. The actual launch should take place in January 1993.

We expect that the market will respond very favorably to the data generated by Landsat 6 because we have added 15-meter panchromatic data coregistered with our seven-band multispectral data. Unlike previous Landsat satellites, Landsat 6 was designed not as an experimental satellite but as a commercial satellite. Thus it relies on proven technology to reliably deliver the data that operational users need.

Proven technology, however, does not mean obsolete technology. Like most other space-based land remote sensing systems that are in operation today, Landsat 6 is based on the technology that was pioneered by earlier Landsats and is dependent on the market created by the data they generated. But Landsat technology has continued to advance, and none of the alternative technologies that some have proposed can fully duplicate the data stream that will flow from Landsat 6. And it is the data stream, not the manner by which it is collected, that is important to users. Designers of other systems, such as SPOT's, have not seriously tried to compete in Landsat's main market, multispectral data, but rather have designed satellites to fill data needs not met by Landsat. This has served to expand the total market, not to displace Landsat. Nevertheless, we would like a larger share of that growing market. That is why we designed the Enhanced Thematic Mapper on Landsat 6 to com-

pete head on against SPOT's specialty (high resolution panchromatic data) while preserving our own advantages.

SUGGESTIONS FOR FINE-TUNING COMMERCIALIZATION

Allow me to turn now to the question of what EOSAT would like to see come out of the current effort to adjust the commercialization process. As I have already stated, we believe that most of the adjustments can be accomplished under the existing law through dialog and cooperation, but some legal modifications are necessary.

1) *Finalize the commitment to construct Landsat 7.* The Administration is moving forward with its plan to procure Landsat 7 competitively. Although this was not foreseen in the 1984 Landsat Commercialization Act, it is consistent with the intent of that law, which called for the federal government to finance the first two satellites after Landsat 5. The Congress must ratify the Administration's plan—or suggest some other appropriate method—and then authorize and appropriate adequate funding. EOSAT is prepared to work within whatever framework the government deems most suitable—quite frankly, because we view ourselves as a space-age information company and not an aerospace company, our principal focus is not building satellites, but receiving, processing, and marketing data. That is the main role the government entrusted us with in 1985 and we hope to continue fulfilling it into the next century regardless of how Landsat 7 is built. While failure to build Landsat 7 obviously would mean that there would be no data to distribute in the future, even a short-term delay in committing to Landsat 7 will hurt data sales from Landsats 4, 5, and 6. Procrastination will undermine confidence on the part of users that the data stream will continue into the future and remain commercially available as promised by the 1984 Landsat Commercialization Act. The United States will needlessly lose market share to foreign commercial systems.

2) *Maintain flexibility in data policy.* I have already noted that Landsat 6 is the real initiation of the commercialization experiment. Until it is launched commercialization depends on data generated by what were essentially experimental satellites. Because we anticipate a strong market response to the data from Landsat 6, we believe that Landsat 6 will radically change the dynamics of the commercial market, demonstrate the viability of commercialization, and open new possibilities for solving current problems. Thus, in considering the Administration's proposal to change the oversight agency for the Landsat program, Congress should allow the oversight agency sufficient authority to formulate a data policy based on the experience that will flow from Landsat 6. We should do nothing now that will preclude continued commercialization when Landsat 7 is launched or that would abort current U.S. preeminence in commercial land remote sensing. If EOSAT's confidence proves ill-founded, this same flexibility will allow the development of a suitable new policy based on the experience that will have been gained. Nothing is gained, however, by setting in stone now data policy for a satellite that will not fly for at least five years, or by cutting short commercialization before it really begins.

Central to the continued viability of commercialization is exclusive data rights. In the absence of exclusive marketing rights, no mechanism exists for the government to transfer land remote sensing to the private sector and flee the taxpayer of the burden of subsidizing data users. EOSAT has been the government's partner in this transfer, and we hope to continue working with the government through Landsat 7. Unfortunately many researchers and government agencies see EOSAT's exclusive rights not as the means for reduced federal outlays but as a barrier to their access to data. Obviously, if commercialization is to work, then we must work together to find real solutions to the dissatisfaction of these researchers and government users while preserving exclusivity.

We hope that our talks with NASA that are laying the foundation for a research data policy for Landsat 6 and 7 will serve as a model for the dialog that is needed with other government agencies. EOSAT believes that the existing legislation offers a flexible framework for addressing their problems. The polarized atmosphere of recent years, however, hindered the dialog that is necessary to make use of that flexibility, but we see signs that that polarization is easing. Among government users, for example, some of the dissatisfaction is the result of their having to contribute to NOAA for the operation of Landsats 4 and 5 in addition to buying data from EOSAT. Full commercial operations beginning this fall will eliminate this irritation. Part of the objections to current data policy from government agencies, however, also arises from prices and data use restrictions. Specific ideas that need to be explored in order to reduce the cost of data to government agencies include bulk data purchases, guaranteed data purchases (as NASA has done with the SeaStar satellite), and price differentials to reflect the level of data preprocessing.

This last option has been ignored completely because of the focus on price reductions for certain user categories. EOSAT believes it would be more appropriate to tie reduced prices to the level of data preprocessing. EOSAT's standard, unenhanced products include a high level of preprocessing, which many users need. Large volume data users, such as those in government and research, may not need such preprocessing, or are capable of doing it themselves. EOSAT's arrangements with the international ground stations could serve as a model for a pricing policy based on the level of data pricing because they pay a flat fee for the right to receive truly raw data in unlimited quantities from the satellites.

Although caution must be exercised in modifying use restrictions to ensure that the commercial value of Landsat data is protected, EOSAT also believes that can be accorded to government agencies. Blanket efforts to lift use restrictions through legislation, however, are likely to make protection of the data's commercial value more difficult. Thus we see dialog between EOSAT and the affected agencies, not the halls of Congress, as the best venue for resolving this problem. As a model for the type of solution that is possible, I would like to point to our statewide coverage program. Under this program a state can purchase coverage of the entire state and then make the data available to all government agencies and contractors without violating the use restriction.

Provide adequate research funds for global change and new technology. I have already discussed EOSAT's proposals to NASA for facilitating researchers' access to Landsat data. Low data prices by themselves, however, are not enough to stimulate increased utilization of the data for global change studies; the sharp decline in sales of Landsat data to academic institutions throughout the late 1970s and early 1980s does not mirror rising data prices, but falling federal research grants. EOSAT believes that commercialization is compatible with wide access to Landsat data by researchers, but the government must do its part both to ensure that researchers respect the need to protect the integrity of the commercial market and that adequate research grants are made available. Knowing the interest of the charms of this subcommittee in bringing about the widest possible use of the data that have been gathered by the U.S. space program, I am confident that the Senate will give serious consideration to the needs of researchers for more grant programs for global change analysis, as well as for the development of new technologies.

ENSURING LANDSAT'S SUCCESS IN THE 1990S AND BEYOND

EOSAT believes that these three steps will help ensure the continuing availability of Landsat data for all users, maintain U.S. preeminence both technologically and commercially in land remote sensing, and greatly facilitate the use of Landsat data for important environmental studies on both the global and the local levels. These recommendations are based on the experience we gained since signing our contract in 1985. EOSAT made its share of mistakes during those years as we tried to rigidly push commercialization forward under less than optimal conditions. But we have learned from both the failures and the successes, and we have built up an important reservoir of information and experience about Landsat, the needs of Landsat data users, and the commercial market. No government agency currently possesses this same in-depth knowledge of the Landsat program. Unless the United States wants only to be a leader in remote sensing technology, and to subsidize foreign commercial land remote sensing systems through technology demonstration projects without being an active player in the commercial market itself, the country cannot afford to overlook or ignore our expense and experience. It is true that EOSAT has a direct stake in seeing commercialization continue. Yet for that reason we are motivated to understand and serve our customers in a way that no government agency ever can be motivated. That is why commercialization was begun, and that is why it must continue if the United States is to remain a leader in land remote sensing in the fullest sense.

What I am saying is "Do not reinvent the wheel." The commercial framework established in 1984 remains sound and the investments that the taxpayers have made in commercialization are about to pay off. EOSAT has expanded sales to the level where revenues can cover Landsat operations, one of the fundamental goals of the 1984 Landsat Commercialization Act. We will be taking over responsibility for Landsat operations even before the launch of Landsat 6, the target date for reaching this goal. Reversing Landsat commercialization now will simply burden the government with expenses that the private sector is wing to cover. Backtracking on commercialization will cost the taxpayers more money.

More attention, of course, must be given to the needs of researchers. In 1984 the dangers of global environmental change did not weigh heavily in anyone's plans for the Landsat program. Public awareness fortunately has changed since that time.

But based on our recent conversations with NASA that I have already mentioned, EOSAT believes that the data needs of global change researchers can be met under the existing commercial structure as it was amended in 1987. Facilitating researcher access to data does not require that the taxpayer pick up the tab for operations—thereby duplicating what EOSAT has already created—as some have suggested. Rather we should support research grants and invest in technology for the future.

The important thing is to fine-tune the existing commercialization act so as to capitalize on our collective investments in Landsat and to provide moral support to EOSAT's efforts to expand the market. Wavering government commitment to Landsat used commercial confidence in the continued availability of Landsat data, hurt sales, and damaged our reputation as a world leader in remote sensing. The market for Landsat 6 data is already being damaged by endless repetition, both in the United States and abroad, of the refrain declaring commercialization dead. Let us not continue to repeat mistakes of the past. Despite the delays that have occurred in commercialization, EOSAT believes that the Landsat 6 era will demonstrate that land remote sensing is a viable and growing business, that the United States can be the world leader in this high technology field, and that abroad commercial market will help reduce the cost of supplying Landsat data to the research community. This can only be accomplished, however, if the public and private sector are willing to work together. As allies and not as enemies, we must jointly dedicate ourselves to progress, not regress.

Thank you.

Senator GORE. Thank you very much. By way of starting, let me pick up on your last comment. You said the real problem was the drop in the grants. Even if a research agency gets a grant, it has to look at the relative value of spending the money for this experiment or that experiment, or this raw data or that raw data. And if it judges the cost of scenes from Landsat to be prohibitively expensive, even with additional grant funding, they are still going to put the money elsewhere rather than using it for these extremely expensive scenes. Would you not agree?

Dr. SILVESTRINI. Yes. But let me amplify on that subject a little bit. You have heard from another witness here today, the ratio of the total project to the cost of the data is about one-twentieth, sometimes one-fifteenth. And that is the data price problem. It is one-twentieth of the problem, one-tenth. So, yes, I agree, the price of the data is essential. There is no question about it, but it is only one-tenth of the problem. I think we have to stimulate that with better things.

Incidentally, one thing I forgot to say is that we are now starting a cooperative agreement with universities to put together a course in this kind of Earth sensing and associated subjects. Now we have been training outside the United States, but never so deep. And I know that what you start now—

Senator GORE. Now you seem to be optimistic about the possible success of this commercialization strategy. And yet there seems to be a very slow growth in data sales and there does not seem to be any near-term prospect of data revenues covering the entire cost of remote sensing, including spacecraft development. Am I missing something?

Dr. SILVESTRINI. No.

Senator GORE. So, what is the basis for your optimism?

Dr. SILVESTRINI. Well, first of all, there are several pieces of your question. One is associated with there is not too much data being sold, and that is right. But we have two satellites up there that are very very sick, and we cannot use the satellites as much as we would like to. We will use Landsat 6 to the full capability.

And we can kill the satellites, by the way. That is the reason, also, for not acquiring all the possible scenes, it is not just that we wait for the order. And this is also part of the negotiation we are doing with NASA. The closer we get to the launch of Landsat 6, the less important it is to preserve the satellites. And hopefully that thing is going to go OK, and so this is one of the reasons.

The second reason is that we have seen the market grow considerably—our own market, and even more SPOT market. The SPOT market, I think, grew more for two reasons. One, it is more modern technology in satellites. But the other one is that they have been always supported by their government in their operation. There was never a doubt that they would be there. For Landsat, until recently, it was a complete mess, so people would tend to go where they know they are going to get their data later.

The third is that despite the fact there is not the highest technology that could be available today, Landsat 6 really is an advancement. And do not forget that Landsat 5 is still very well appreciated by everybody—6 is better, 6 is getting closer to SPOT. As a matter of fact, it is the first Landsat that will compete with SPOT. As of now Landsat and SPOT do not compete. We do not do what they do, and they cannot do what we do. In fact, we indicate to our clients to go to SPOT when they want something. Landsat 6 will compete with SPOT, so that will help our market too. I am not going to go into 7.

Four, we do not have to wait for anybody to authorize us to do anything more than just distributing data. We can do it. And that is exactly what we are doing now. What I am doing now is to put together EOSAT with foreigners and local companies, to create something which will help, even more, the taxpayer in the future, if we are there.

Senator GORE. This has been an expensive mistake, as far as I am concerned. This whole thing reminds me of the swine flu program.

Dr. SILVESTRINI. We could have done it different, and by now we would be much further ahead.

Senator GORE. Well I have some other questions, but let me yield to Senator Pressler.

Senator PRESSLER. Thank you very much, and welcome here, Mr. Silvestrini. I appreciate very much your coming.

And let me say, first of all, that I think a mistake in public policy was made and now we have to correct it. But I did listen with interest to your comments. You said that you were not necessarily opposed to any of the legislation, if I understood you correctly.

But your organization ran an ad in the Washington Post, which I have a copy of here, which says that—which sounds like you are very much opposed to it. It says: "Legislation in Congress aimed at distracting, modifying the marketing structure for the data, could significantly change the course of events and result in the disappearances of Americans in this commercial market and the loss of U.S. prestige."

So, that certainly sounds to me like EOSAT is opposed to our legislation.

Dr. SILVESTRINI. I am personally opposed, and EOSAT is, to some aspects of your legislation; yes.

Senator PRESSLER. This certainly sounds like—this ad says that your organization—and did you approve of this ad?

Dr. SILVESTRINI. Yes.

Senator PRESSLER. It says you are opposed to the legislation.

Dr. SILVESTRINI. Correct. The way it is, yes, like I was with Mr. Brown's legislation. I approved the principle completely, but like Mr. Fisk—Dr. Fisk, and Mr. Faga said, I think we are at the point where we can solve the problem without having an edict that might prevent some other things to happen which are even better.

I am not sure, but to me, with our intention, which is very open and very sincere, and with NASA's intention, I think we can reach the same conclusions and at the same time allow us to continue to derive profit from the commercial sales, which will help, in turn, NASA in defraying costs for operations. It is as simple as that.

Senator GORE. Would you yield just for a minute on this ad?

Senator PRESSLER. Of course.

Senator GORE. You said a minute ago that we are—with the next Landsat we will approach the quality of SPOT.

Dr. SILVESTRINI. Correct.

Senator GORE. This says we are already better than SPOT.

Dr. SILVESTRINI. I do not remember that.

Senator GORE. OK. It says, under the paragraph better: "Landsat is the best available source of space-acquired information about our planet's natural resources. No other system——"

Dr. SILVESTRINI. Natural resources, yes. SPOT is superior to the present Landsat in terms of spatial resolution. In terms of spectral resolution there is nothing, not even the Japanese, better than us.

Senator GORE. Well it goes on to say: "No other system, domestic or foreign, is capable of delivering a level of information comparable to Landsat's."

Dr. SILVESTRINI. From that point of view, yes. The combination of spatial and spectral that Landsat would offer is extremely competitive.

Senator GORE. Competitive or the best?

Dr. SILVESTRINI. It is the best from the point of view that it is also the cheapest. You have heard Al Watkins say it before, that it is cheaper by what they can offer. Comparing the size of the scene that they can get and what we can get, the Landsat price is about five to nine times cheaper than SPOT. It depends upon how you look at it, not less than four or five.

Senator GORE. I will pursue this on my own time.

Senator PRESSLER. I think this is important because, as I said earlier—and I do not want to criticize EOSAT because it is doing a job under the public policy. But on the other hand, with this ad you enter the debate, you enter the fray, so you will not be critical of me if I ask you some questions.

Dr. SILVESTRINI. Absolutely not.

Senator PRESSLER. How much did this ad cost and who was the audience you were aiming at with this ad?

Dr. SILVESTRINI. \$5,200.

Senator PRESSLER. And what are you trying to accomplish with this ad?

Dr. SILVESTRINI. Essentially, to raise your curiosity. [Laughter.]

Next time I will come to see you directly in your office, and I will not have to spend \$5,200. [Laughter.]

Senator PRESSLER. That is a good answer, I guess.

Dr. SILVESTRINI. I think I have a good story to tell you, that is all.

Senator PRESSLER. Well it did raise my curiosity in a number of areas. Now when do you envisage that EOSAT could launch a totally commercial Landsat-type system without funding being provided by the Government?

Dr. SILVESTRINI. That is still not around the corner. What we can do now is a piece of what we are supposed to do in the original law, which is to operate the satellites at no cost to the Government. We can do that. And, by the way, we have also contributed significantly to both the ground and the space segments of Landsat 6—\$22 million, for a company of 100 people like us, is not peanuts, but we have done it.

I think we would increase revenue with Landsat 6, and with the addition of the other initiatives I was talking about and continuing our talks with the agency of the Government that would be responsible for it, I think we would contribute more and more and more. When we can get to the point of building a satellite ourselves? Not with the present concept—but, again, one of the things that I am hoping for very strongly is to put together a consortium of others to reach that conclusion.

Senator PRESSLER. Now is EOSAT making money?

Dr. SILVESTRINI. Yes, otherwise we could not be in operation.

Senator PRESSLER. What are your annual profits?

Dr. SILVESTRINI. Unfortunately, Senator, that is one of the things that EOSAT's parents, told me not to talk about at this point in time. We are a privately held company, we are not a company for sale to the public. We are a joint venture.

Senator GORE. Wait a minute. Would the Senator yield?

Senator PRESSLER. Yes.

Senator GORE. You are a private company but most of your revenue comes from the U.S. taxpayers, and we are debating legislation that proposes a change in this arrangement. And the profits your company is making are directly relevant to our ability to understand how stupid the legislation is.

We have established that it was stupid, but the full extent of its stupidity can best be assessed with full access to all of the information relevant to that determination. And so I would urge you to reconsider what you just said, that you will not tell us what your profit-and-loss statement reflects.

Dr. SILVESTRINI. I have to defer the question until later. I really do not know how to answer this question today. I am sorry to say that. If I can find a way to—

Senator GORE. We cannot compel you to answer the question.

Dr. SILVESTRINI. I wish I could.

Senator GORE. In this proceeding, we cannot compel to answer the question, nor would I contemplate that we would go through the legal mechanism—

Dr. SILVESTRINI. I wish I could.

Senator GORE [continuing]. That is available to us. But you must understand that refusal to provide information of that kind would

be viewed, during the consideration of Senator Pressler's legislation, as quite relevant. So, we will hold the record open in case, after consulting with others, you determine that it would be OK to modify mom and dad's recommendation.

Dr. SILVESTRINI. I appreciate it.

Senator PRESSLER. I thank my chairman for his strong support on that. Because there have been articles, like in Space News, "EOSAT struggles to repair tarnished reputation." There is—"EOSAT history include controversy, management shifts." I am not criticizing that, but with this ad you stepped into the public arena—and you are in the public arena already, but with this ad you are spending money, presumably from the profits, to oppose legislation in Congress. So, we need to know some of these things.

I would also like to ask that you would provide the annual EOSAT revenue from the sale of products and from foreign ground stations; access fees each year from 1985 through 1992, EOSAT salary structure for their top executives, and other information that I will ask for for the record. Do you think you can provide this to us?

Senator GORE. He is going to consult on that, I think was his response.

Senator PRESSLER. I just wanted to lay out the reasoning behind my portion of the request.

Dr. SILVESTRINI. I would be more than pleased to provide to you all of the information we can, at any time.

Senator PRESSLER. Now how much money do you have in reserve for grants?

Dr. SILVESTRINI. The mechanism is this: NASA pays for the data. Whatever they pay we will put back into the grants. We expect, then—to the end of this fiscal year they told us that they have about \$800,000, but I am not sure.

Senator PRESSLER. That is the total figure.

Dr. SILVESTRINI. Yes. I am not sure, though. This is approximate.

Senator PRESSLER. Now how much data will go to our Nation's data archive when you assume control of Landsat 4 and 5? Will we see a decline in the archive data stream?

Dr. SILVESTRINI. This is part, also, of what we are talking to NASA about. That is a function of how much the satellites can afford to put down, really, more than anything else. It does not cost to us to get the data down, but we want to make sure that we do not kill them too much ahead of time.

Senator PRESSLER. Now let me understand something. In this article it quotes you as saying we are trying to expand the scope of EOSAT beyond just selling of Landsat data.

Dr. SILVESTRINI. Correct.

Senator PRESSLER. What other value-added services do you intend to engage in?

Dr. SILVESTRINI. It is not just the value-added. First of all, if it is value-added, it will not be in competition with our value-added clients. It would be something that—it would be joint with them in some cases. And what I am thinking about is using the EOSAT resources acquisition capability marketing to distribute and work together with other satellite data.

I heard before in one of the testimonies, for instance, that it was very important to have radar data. We are not in competition with Landsat. It would be very good to have Landsat and radar data. Those are the things we are studying now.

I do not have the details because I just started on this thing.

Senator PRESSLER. Now, I do not know—I think you are familiar with the OMB Circular A-130 that has been discussed here.

Dr. SILVESTRINI. Not in-depth, but some.

Senator PRESSLER. Now, what would be the impact of deleting the section within the bill which specifies that the cost of Landsat data, "not exceed the marginal cost of filling a specific user request and allowing NASA to negotiate with EOSAT a policy that conforms with OMB Circular A-130"?

Dr. SILVESTRINI. I think we need to define "marginal" better. It can be from anything between disastrous and nothing. It depends upon what "marginal" means. And we are doing that, too.

Senator PRESSLER. Now earlier today we heard from over 25 environmental and consumer groups and other groups that support the nondiscriminatory access and marginal cost provisions in this piece of legislation, S. 2297. Other than EOSAT can you think of any other group in America that opposes our nondiscriminatory access and marginal cost provisions?

Dr. SILVESTRINI. We have not made a survey of these kinds of things. I am opposing pieces of it for the reason I stated before. It is just because we will waste something we already have accumulated that already can be used.

Other people would probably like to have data at the lowest possible price. But by doing that and not taking advantage of the fact that something can be done by others, paying things, we are just giving the burden on the taxpayer. I am trying to reach a compromise on this thing, not so much to protect EOSAT.

Senator PRESSLER. Now would you define "marginal cost" to include the operation of the satellite?

Dr. SILVESTRINI. It depends. Again, we can—if we include the cost of the satellite and the operation of the satellite, then the price is going to be even higher—probably twice as high than what we pay now, what we offer now.

I mean the program that I saw in Government plans so far is very expensive. The entire program for Landsat 2 through 6—if I can put together numbers—but I am not sure if I have all the numbers—is anywhere between \$350 and \$400 million, so far. And from now on, 4 to 6 are not going to cost the Government any more, if we are allowed to stay in the picture.

In addition to that, the Government, the researchers, and others will have a benefit. You heard about what we are doing with the States, a very progressive approach. We are trying to do the same thing with some of the agencies of the Government, especially DOD.

If you look at Landsat 7, the way it is structured now, I am not sure if trying to do for 6 what we plan to do for 7 will not result in either the taxpayer absorbing everything, or the prices going up. By what? Twice, if you pass on the entire cost. That is a lot. This is why the recommendation has not worked yet.

Senator PRESSLER. Obviously you are not responsible for the system as it was set up, and the mistakes that were made. But if you begin to use the funds of your company to advertise in newspapers against any change in it, well then obviously you have to take—we can take some—we can have a very heated exchange, which I will not do today.

But let me ask you this: How do you see us getting out of this public policy problem? We have a practical problem. I have a problem as a Senator from South Dakota, as a U.S. senator. How do we get these images to our people at a reasonable price? We cannot go on paying \$4,500 per picture.

Dr. SILVESTRINI. Absolutely not. And we are working on that, exactly on that. There are pieces of the user market that is more than willing to pay that much. And as long as they are there, and they are in the numbers that I have seen so far, we should use that to subsidize the part of the program to allow the others to pay less and not to have an entire burden on the taxpayer.

That is my point, how to do it. Probably it is not legislation at this point, simply because all of the facts are not clear to me, to you, or to Mr. Brown on the other side—not yet. And that is why, I think, the reason why Faga and Dr. Fisk suggested to slow down with this thing. Because we are getting there.

Senator PRESSLER. Well, I will have some additional questions for the record.

Mr. Chairman, let me say, listening to the witnesses today, no one knows what would happen to data policy if we follow NASA on EOSAT to—if we allow them to negotiate along the lines of OMB Circular A-130. I am really more convinced now, after this hearing, that we need a rigorously defined Landsat data policy. And I thank you very much.

I have some additional questions for the record.

Senator GORE. Let me just say that I was checking on your comparison of the cost of SPOT. And I had forgotten that you really have to—you are comparing apples and oranges in the sense that the image area is so different.

If you make the assumption that each purchaser wants the entire image area given in a Landsat image and compares that to SPOT, you multiply by 9, roughly, because the SPOT image area is much smaller. So, when you say it is the cheapest, you have to make some assumptions.

Dr. SILVESTRINI. Correct.

Senator GORE. In making that statement, I have a number of other questions for the record.

I appreciate your tone and approach, Dr. Silvestrini. You have a difficult brief to carry. I know you are new to EOSAT and I appreciate your appearance here today. I do urge you to consult with your company and think again about the answer to Senator Pressler's questions.

We will continue to be in touch with you. And if you would respond to these additional questions for the record that would be much appreciated.

We have a very tough job on our hands to work through this policy.

Dr. SILVESTRINI. I do not envy you.

Senator GORE. Well, thank you so much. We will do our very best. And as you negotiate with NASA, even though—as you said—the offer of these grants and the offer of negotiating lower prices for researchers and so forth had absolutely nothing to do with pending legislation.

I hope that your board will realize that, indeed, legislation is pending and it is as serious as a heart attack, as they say.

Dr. SILVESTRINI. We are doing it anyway because we want to give something to somebody, starting not next year.

Senator GORE. Well, thank you very much and thanks to all of our witnesses today. And thanks to Senator Pressler for bringing this legislation forward. We will be considering it along with other potential remedies. And we will have more to say about it as a subcommittee.

Thank you. We stand adjourned.

[Whereupon, at 1:10 p.m., the subcommittee adjourned.]

APPENDIX

PREPARED STATEMENT OF SENATOR DASCHLE

Mr. Chairman, thank you for this opportunity to express my concern regarding the future of the Landsat program. I appreciate your addressing this important issue as chairman of the Senate Subcommittee on Science, Technology, and Space in your hearing today.

The data that has been collected by the Landsat program is of great value, from data used for scientific research on global change to that needed for national security, as in the recent images used by our military in the Persian Gulf conflict. These are only two examples of how the Landsat program has proved to be an important scientific achievement.

Unfortunately, the course that Congress and the Administration set for the Landsat program in the mid-1980's that would transfer its management and operation to the private sector has not developed as expected. We have now reached the point where it is imperative that we reevaluate the current policy and our objectives for the future of the Landsat program.

I would urge your subcommittee to address the current status of archived Landsat data. This data, most of which is archived at the Earth Resources Observation Systems (EROS) Data Center in Sioux Falls, South Dakota, is of great value in scientific research. The Landsat policies we develop in this Congress need to ensure that data collected by the Landsat system continues to be well preserved and accessible for scientific and commercial use in the future.

Another important consideration for the Landsat program is the continuity of data. As Landsat 6 nears completion and is prepared for launch and operation, we can waste no time in preparing for its successor, a Landsat 7 satellite. Our policies must address those procurement issues that will provide a high quality Landsat system at a reasonable cost to the federal government. The private sector also can play an important role in the development process and in sharing the costs and benefits of the Landsat program. We must examine these options closely. Ultimately, we must not allow our Landsat program to lapse, leaving future researchers with disappointing information gaps. We can and must do better than that as we develop Landsat policies.

Scientists and other researchers actively involved in studying the global change of our planet or developing other research that will benefit our nation and all mankind should be encouraged to continue their good work. We must design policies that will allow acquisition for important scientific research of valuable Landsat data at the reasonable cost of reproduction. This kind of action will undoubtedly facilitate and encourage further valuable research.

Foreign competition in Landsat technology has become much more intense in recent years, and the United States will need a comprehensive Landsat program to maintain a world leadership position in Landsat technology. It is my hope that we can develop a program that will continue the beneficial archiving practices we have in place, provide for the continuity of data from the Landsat system, establish fair pricing policies for this data used for important scientific research, and establish a viable commercial market for Landsat data in the future.

Finally, I want to acknowledge the efforts of the ranking member of the Subcommittee and my senior colleague from South Dakota, Senator Pressler. He has taken a special interest in this area, and I applaud his efforts to ensure that we maintain a sound Landsat program.

Again, Mr. Chairman, I appreciate your work on this important issue and look forward to following the developments related to this hearing.

QUESTIONS ASKED BY SENATOR GORE AND ANSWERS THERETO BY MR. SILVESTRINI

SUCCESS OF COMMERCIALIZATION

Question 1. Mr. Silvestrini, in your statement you argue that "facilitating researcher access to data does not require that the taxpayer pick up the lab for operations. * * * Rather we should support research grants. * * *" Isn't that still a government subsidy to EOSAT?

Answer. No. As of October 1, 1992, EOSAT will pay the cost of all operations, including production, thereby relieving the taxpayer of this burden. Research programs in the United States are generally subsidized; government grants are given to researchers to perform all aspects of a research project, including, if necessary, buying data. These are subsidies to researchers, not to EOSAT. Letting EOSAT pay operations costs would mean that there is more government money available to support research. (Note that for an average project the cost of data is only a small fraction of the project's total cost.)

POSITION ON S. 2297

Question 2a. Mr. Silvestrini, in your testimony, you have stated that we do not need legislation for Landsat. Instead, you advocate "fine-tuning" the existing commercialization law. You also have stated in the past that you are opposed to S. 2297. Can you tell the Subcommittee your reasons for opposing the bill?

Answer. EOSAT believes that passage of the bill as currently drafted would prematurely and unnecessarily abort the commercialization experiment which realistically begins with the launch of Landsat 6 in 1993, although commercialization has already saved the taxpayer money. S. 2297 as we know it would instead cost the taxpayer more because the operations costs of Landsat would be borne again by the government.

In the area of Earth observation the US has been a leader. With respect to supporting new initiatives in commercial exploitation of space, the US has also played a key leadership role. S. 2297 would reverse the commercialization process, and in effect, nationalize the program just as the commercial benefits are being solidified. Typically, the US does not nationalize companies. Enactment of S. 2297 would lead to a reversal of US policy and send a strong "anti commercialization" message to other countries.

Lastly, EOSAT believes that under a commercial landsat system the availability of data will be greater than if the system were returned to government control. We base our position on the history of the Landsat program when it was under government control. During these years, data were available, but not in a timely fashion; and only a limited product selection was provided. Since EOSAT assumed operations of Landsat 4 and 5 in 1986, the number of products has increased from two to ten. This type of advancement would probably not occur if Landsat system were placed under government control as suggested in S. 2297.

Question 2b. What do you mean by "fine-tuning" current law?

Public Law 98-365 attempted to accommodate a broad range of desires on the part of the Congress, the Administration, and the user community. Specifically it sought to provide continuity to the Landsat program which the Administration had decided not to fund. However, since enactment of the Land Remote-Sensing Commercialization Act of 1984 (Public law 98-365), the world has changed. The importance of the global change research program and the role that Landsat had in Operation Desert Storm could not have been predicted when the 1984 law was drafted. We see, based on these developments, that the role of academia and the government in the market is changing, and that modifications in pricing or data use restrictions should be considered for these communities. The current law could be modified accordingly. We would be happy to work with the Subcommittee staff in developing possible changes to the existing law (or, in fact, to S. 2297 instead) which would reflect present realities.

EOSAT is further concerned by S. 2297's philosophical approach to pricing. We would agree with the Administration witnesses, and recommend that issues of pricing be solved in regulation not legislation. We believe that S. 2297 moves too boldly to implement solutions now for systems (Landsat 6 and 7) which have not even started to produce data (or affect the market).

Question 2c. As currently drafted, the Pressler bill would not preclude EOSAT from moving into another aspect of the land remote sensing industry, such as a value-added company. Isn't that correct? In fact, isn't EOSAT already moving toward doing some value-added work now?

Answer. As currently drafted, S. 2297 would leave EOSAT with only the option of entering the value-added business. During the past six and a half years we have

worked diligently to develop the business infrastructure needed to support a truly commercial enterprise. This infrastructure is based on the existence of a growing, energetic value-added business component in the United States. Forcing our entry into the value-added business at this time would have a negative effect on the growth which is currently taking place, and detract from the US competitiveness in the international arena.

EOSAT has invested enormous effort to develop uses of the data and educate potential users to the benefits of remote sensing. We have seen the progress of commercialization because of our educational activities and of the success of the growing value-added business. EOSAT will base its entry into other "service" areas (not necessarily value-added) only on sound business decisions. Certainly, we will do nothing to compete directly with value-added companies presently in business.

TERMINATION COSTS

Question 3. Senator Presslers bill proposes that the Federal government recover ownership of the data rights that, as now, are retained by EOSAT. What are your estimates of the liability costs EOSAT believes would be incurred if such action was taken? How did you arrive at those costs?

Answer. EOSAT's contract with the Department of Commerce requires that EOSAT operate the Landsat 6 system and market the unenhanced data sensed by Landsat 6. The government does not pay for either the operations or marketing expenses for the Landsat 6 system. Instead, EOSAT is entitled under the contract to (1) access and distribution fees for supplying data to the international ground receiving stations and (2) to the revenues generated through exercise of its exclusive marketing rights for Landsat 6 data. Furthermore, the Department of Commerce contract specifically prohibits unilateral modification of the operations and marketing clauses of the contract. In addition, termination of the contract for convenience of the government is prohibited. In fact, the government's unilateral modification or termination of EOSAT's rights and responsibilities to operate the Landsat 6 system and to market unenhanced data sensed by Landsat 6 would constitute a breach of contract. If such a breach would occur, either through administrative or legislative means, EOSAT would be entitled to compensatory damages that would put it in the same monetary position as it would have been, had the modified or terminated sections been fully performed. The compensatory damages would include recovery of EOSAT's investment in the program as well as EOSAT's prospective profits.

We estimate that damages accruing to EOSAT if such a breach of contract was permitted would be in the range of \$150 to \$200 Million. We base this calculation on the potential income from Landsat 6 products for at least the estimated 5-year life of Landsat 6 plus the continued marketing rights to data for 10 years past the date of the data acquisition. In addition, there would be unrecovered investments (for instance, the Norman, Oklahoma ground facility that would be part of the compensation package) and other contract related considerations.

MARKETING RIGHTS

Question 4. The Landsat Act provided that the contractor selected to operate the system have exclusive marketing rights for the data collected. Regardless of the outcome of the debate over Landsat data pricing policies, why should the Federal government continue to grant a monopoly, which has been subsidized through the development of the spacecraft, on Landsat data sales, much less let such a company set prices without regulation?

Answer. Briefly: Because continuing private-sector operation costs the taxpayer nothing (vs. considerable expense if Landsat reverts to the government); because the market is still too small for more than one US operator (let alone the international market, where we have to face SPOT); and because price regulation could destroy the overseas market penetration (what is needed is, instead, less regulation than now exists—a position supported by the Administration).

A more in depth response to the Committee's question requires some review of the historical context of the Landsat effort. In 1980, the Reagan Administration, as part of an aggressive program to shrink the size of federal government programs by transferring activities to the private sector, targeted Landsat for wholesale transfer to the private sector. The following year the Department of Commerce was directed by OMB to consider either transferring to the private sector (by competitive means) the operational civil land remote sensing satellites or bringing the remote sensing system to a close by 1988 or sooner. The Secretary of Commerce appointed the Civil Operational Remote Sensing Satellite Advisory Committee (CORSSAC) to evaluate these options. CORSSAC found, among other items, that:

- 1) the commercial market for Landsat data was underdeveloped because the government had an experimental program which did not provide data operationally;
- 2) the government had no agenda to develop commercial markets for the data;
- 3) at least two additional satellites beyond Landsat 5 would be required to transition the program to operational status;
- 4) Landsat 6 and 7 would have to be supported by the government to effectively transition the experimental program to an operational program and to develop the commercial market for the data; and
- 5) successful commercialization of the Landsat program should be done gradually, beginning with the ground data distribution segment, but in a manner that would not adversely affect the already developed commercial markets in value-added data processing and analysis.

These observations served as the backdrop for the decisions made by Congress in the 1984 Act. The Landsat Act (Public Law 98-365, the Land Remote-Sensing Commercialization Act of 1984) recognized that the market for Landsat data was not sufficient to support more than one commercial marketing operator and provided a mechanism to begin commercialization of the marketing rights and the space segment. During the debate, Senator Hollings referred to the concern, in the user community, that data would be increased for the then-current federal data prices. (See Congressional record, June 8, 1984, at S. 6858.) At that time, the NOAA price for the standard full Thematic Mapper scene was \$4400. Senator Hollings stressed that the data prices should not be higher than current federal prices, noting:

"The Senate bills emphasis upon the importance of the marketing of remote sensing data and data continuity is meant to reflect the committee's position that broader markets and reliable services—not higher data prices—are the keys to successful commercialization. In addition, the advent of foreign competition should help restrain price increases. * * * Id

Senator Hollings finally observed that the average annual cost for continuation of the existing Landsat system was approximately \$183 million per year. He concluded by noting that "the current Federal system is unable to generate a revenue base adequate to off-set operating costs. * * * In promoting the commercialization, the Presidential decision memorandum recognized that the Landsat operator would need up to \$150 million per year, while the market was being developed. The Secretary of Commerce (charged with the responsibility for the commercialization) initially received seven bids, most featuring subsidies on the order of \$500 million. On technical grounds, these proposals were winnowed down to two: EOSAT, then a joint venture of RCA and Hughes Aircraft, and a partnership between Kodak and Fairchild. Ultimately, the Administration agreed to a cap on Landsat subsidies of \$250 million. The Presidential staffing memo prepared for the meeting approving this compromise subsidy noted that the Landsat system currently "recovers less than 25 percent of the annual operating costs of \$40 million per year."

On September 19, 1984, the Secretary of Commerce provided a Report to Congress on the proposed contract with EOSAT (the Public Law 98-365 contained a 30-day report and wait provision) and its obligations and responsibilities. A central feature of EOSAT's obligations was the establishment and maintenance of marketing organization "to develop and ensure the growth of the Landsat data market and define the requirements for new data products." The precise nature of the relationship with government is precisely detailed in the Report:

"There is no direct financial return to the US Government. Instead, the costs to the Government has been limited to budgeted levels and any revenues above costs are available for investment in the follow-on commercial system.

"All revenues collected by EOSAT during the Landsat 4 and 5 phase will be invested in market development efforts and ground segment facility, as part of EOSAT's equity investment in the program. This investment of revenues is integral to the EOSAT approach for a viable commercial industry to emerge from the program."

Against this background, and in conformity with the obligations imposed by the contract, EOSAT commenced the commercialization. One of the first steps was a reduction in price charged for the standard TM scene from \$4400 charged by NOAA to \$3300. That price remained in effect until 1989, and only late last year did the price return to the level charged by NOAA in 1985 (but still 20 percent lower in real, inflation-adjusted dollars). At the same time EOSAT drove the cost of operations for the Landsat 4 and 5 down from a 1985 level of \$40 million per year to under \$20 million annually and beginning October 1, 1992, EOSAT will absorb all the costs for operations of Landsat 4 and 5, as well as all operational costs for Landsat 6 following launch. It should also be observed that when EOSAT took over responsibility for the system in 1985, the satellites were not fully functioning and were thought to have very limited life expectancy. Through careful and creative

stewardship, EOSAT (in conjunction with NOAA and NASA) has been able to maintain and enhance the performance of these two satellites well beyond their design lives. This action prevented a data gap which had been predicted by most observers to result from the innumerable delays encountered with the launch of Landsat 6. EOSAT has developed a domestic and international marketing team to help expand markets and sell Landsat data worldwide. We have also developed innovative new products in response to user needs. In addition, we are diligently working to open new markets and data applications, and providing technical support to customers. The investment by EOSAT to develop a virtually nonexistent market with two aged and faltering spacecraft, resulted in a remarkable growth in sales for, and applications of Landsat products. This growth and market development has served as a catalyst for industrial growth and jobs. EOSAT itself has 104 employees and during the last few years has watched dozens of new companies being created to add value to Landsat data products. In Maryland alone, ten new value-added companies have entered the marketplace in the past five years. We would also note that during the turmoil over funding for Landsat 6, EOSAT offered a fixed price contract for the spacecraft and contributed a substantial amount of funding from its data sales to offset the cost. Before the most recent developments, EOSAT offered again to build, on a fixed price basis, the next spacecraft, Landsat 7, at a cost well below the one estimated now by the government.

In summary, EOSAT has made a unique and significant contribution to maintaining and developing this program both in terms of corporate investment and intellectual support. It has driven down cost, opened new markets, and in the darkest days of the program, was one of its few supporters.

Question 5. How does continuation of this practice help ensure that the public interest is being served?

Answer. In the past five years, EOSAT has learned a number of lessons that will allow us to continue to operate the system for significantly less than the federal government with a better product and superior service. We believe that based on its proven track record, EOSAT should continue to be the exclusive marketing distributor for Landsat data. In 1984, Senator Hollings, in reviewing the arrangement between the private sector and the government set out in the Commercialization Bill concluded, that it was a good deal for the taxpayer. We believe the same is true today.

The Congressional Budget Office also supports the conclusion that the private sector offers the best option for operating the Landsat system. In its report on "Encouraging Private Investment in Space Activities" (February 1991) stated (p. 75):

"Maintaining the private sector as an operator of Landsat would probably permit the current assortment of land remote sensing data to be produced at the least cost to society. EOSAT's track record supports the belief that the private enterprise, with its freedom to make new cost-saving investment, can lower production cost. Moreover, if satellite costs were shared between the federal government and the private operator, and the federal contribution limited to a fixed amount, the government could avoid the risk of overruns in satellite construction—as it has in the current arrangement to build Landsat 6. In the long run, however, keeping private investment in remote sensing alive would retain the possibility of commercializing the entire system, or of broadening the scope of private investment to include the distribution of data produced by other systems.

"Should EOSAT be retained as an operator of the system under this option? Any change from the current organization of production would introduce new stress in a system that has already been transferred from one federal operator to another and then to EOSAT. A new operator would essentially start from point zero yet again."

As noted above, the nominal price for the standard full TM scene is equivalent to the cost in 1985, but significantly less in real dollars. Remote Sensing data is truly a global market place with competitors in France, Russia and India. These countries will soon be joined by Canada and Japan. There is no monopoly in remote sensing. The international marketplace serves as the "regulator" of prices and if EOSAT—or any other participant—hopes to retain and improve its market share, its prices must be competitive and attractive to purchasers both domestically and internationally.

DATA GRANTS

Question 6a. Mr. Silvestrini, as you have testified, EOSAT has engaged NASA in a dialogue over possible data grants for global change researchers. Why hasn't this

type of proposal been made are the Congress began considering legislation affecting EOSAT's future?

Answer. EOSAT already provided a research data grant to NASA in 1989 in support of NASA's Environmental Observation Commercialization and Applications Program (EOCAP). This grant supported approximately \$350,000 of NASA research sponsored under a NASA Announcement of Opportunity to the research community. EOSAT's current proposal to NASA dates back to November 1990 and immediately follows my joining EOSAT, not necessarily any proposed legislation.

Question 6b. Am I wrong in noting that these proposals will only be in effect until September 30 of this year? What is the reason for limiting your proposals in this fashion?

Answer. Our proposal to NASA for data grants is intended as a pilot program designed to lead to development of a long term data policy for Landsat 6 and beyond. The program will expire September 30 because NASA has funding only for this fiscal year for data purchases, and because NASA needs the data quickly. We are continuing to analog with NASA the Landsat-6 era situation.

Question 6c. While this type data grant will help environmental researchers doing work for NASA, will it help other Landsat data users? What types of pricing reductions have been offered to other academic, government, or non-profit researchers?

Answer. Our data grant proposal does not specify, or imply the type of research which NASA should support with grant data. We encourage broad application of Landsat data for a wide range of research opportunities. The language of the MoU which was signed by EOSAT and is close to being signed by NASA does not restrict NASA in its use of grant data for research.

With respect to the question of price reductions, Public Law 98-365 requires that Landsat data be supplied on a nondiscriminatory basis, except as noted in Section 504 which deals with special provisions for data grants. EOSAT has always been receptive to unsolicited proposals to support special projects such as unique research or demonstrations. However, our efforts have been directed toward cooperation with NASA or similar agencies on the subject, because we are not equipped to provide rigorous peer review and criticism of the merits of researchers proposals.

Within the limits of our statutory authority, we have made special provisions with government agencies to provide special services at reduced prices. The Persian Gulf War was an example where the government was given broad usage provisions and accelerated delivery of data. We are actively pursuing similar, and broader arrangements with agencies of the US government for the future.

LANDSAT 6

Question 7a. As you are well aware, Landsats 4 and 5 may cease operations at any time, having long ago exceeded their three-year design lives. Landsat 6 has been in development for a number of years and is needed to ensure data continuity. What is the status of the Landsat 6 spacecraft?

Answer. Currently Landsat 6 is going through extensive environmental testing. Following the environmental tests the spacecraft will be shipped to the Western Test Range at Vandenberg Air Force Base for integration with the launch vehicle. The launch window, established by the USAF, is centered around January 22, 1993.

Question 7b. What has been the cause of the delay in launching Landsat 6?

Answer. The major cause of delay for Landsat 6 was associated with the Shuttle Challenger disaster in 1986, followed by the disappearance of the Vandenberg Shuttle launching opportunity (which required complete redesign of the spacecraft for an expendable launch vehicle) compounded by subsequent budget difficulties at NOAA. After the program was restarted in April 1988, there was a further delay associated with a lack of space-hardened MOS and Super CMOS electronic chips. The lack of space hardened electronic components was industry wide and did cause delays in a number of other space programs.

In November 1991, when I joined EOSAT, one of my first actions was to review the status of Landsat 6. At that time I became uncomfortable with the level of testing scheduled for Landsat 6 and I requested concurrent judgment by the integrator (GE). The result was a revision in the spacecraft integration schedule to permit more substantive testing. NOAA was immediately advised of our decision and agreed with the recommendation. Under the new schedule the spacecraft will be delivered to the launch site in the late fall.

FINANCIAL STATEMENTS

Question 8. Following up on questions that Senator Pressler and I raised at the hearing, please provide to the Subcommittee EOSAT's financial statements for the

last five years. In addition, we request information on EOSAT's net data sales for 1986-91 in a manner similar to the attached statement.

Answer. EOSAT submits complete, audited, financial statements to NOAA. These have been summarized on an annual (calendar year) basis below. It is not EOSAT's practice to publish sales by customer. If fact, we have worked diligently to protect against dissemination of this information at the request of our customers. We would be happy to meet with the Subcommittee staff to discuss in detail questions relating to the financial aspects of the program.

Data Sales, 1986-91

Calendar year	1986	1987	1988	1989	1990	1991
Data Sales (\$1000s)	9,373	9,738	8,622	10,194	13,599	14,730
U.S. Gov't Sales (\$1000s)	5,658	6,042	4,455	4,524	6,021	6,711
Ground Station fees (\$1000s)	5,939	7,224	7,400	7,832	8,046	7,832
Number of Stations	9	11	11	12	13	12

QUESTIONS ASKED BY SENATOR PRESSLER AND ANSWERS THERETO BY DR. SILVESTRI

Question 1. Starting October 1, 1985 when the NOAA/EOSAT contract began through March 1992, provide the dollar amount of revenue received by EOSAT, by year, from data sales and foreign station access fees and royalties. For each of these years provide the dollar value of revenue resulting from the sale of data products to the U.S. federal government. For each of these years provide the dollar value of revenue from foreign station access fees and royalties.

[In thousands of dollars]

Categories	1985—4th quarter CY 1985	1986	1987	1988	1989	1990	1991	1992—1st quarter CY 1992
Total Data Sales ¹	\$1,350	\$9,373	\$9,742	\$8,643	\$10,208	\$13,609	\$14,758	\$2,506
U.S. Government Sales	449	5,658	6,042	4,455	4,524	6,021	6,711	1,017
Ground Station Fees	1,409	5,939	7,224	7,400	7,832	8,046	7,832	1,808

¹ Includes sales of miscellaneous items (posters, etc.) from 1987 through March 1992.

Question 2. Starting October 1, 1985 when the NOAA/EOSAT contract began through March 1992, provide the dollar amount of revenue received from NOAA, by year, to cover costs associated with the operation of Landsats 4 and 5 and related data processing, distribution, customer services, and other EOSAT expenses.

[In thousands of dollars]

Categories	1985—4th quarter CY 1985	1986	1987	1988	1989	1990	1991	1992—1st quarter CY 1992
Operations Revenue ¹	\$1,525	\$2,373	\$2,561	\$1,588	\$2,498	\$1,570	\$1,381	2,298

¹ Includes equipment relocation in 1988 and 1990.

² Includes \$752K in CY 1985 and \$1,542K in CY 1990 to relocate Landsat operations from the Goddard Space Flight Center in Greenbelt, MD, to a facility collocated to EOSAT in Lanham, MD.

Revenues received from NOAA for the operations of Landsats 4 and 5 only covered the costs associated with the spacecraft's command and control, the reception of data, and data processing associated with updating catalog archive listings and the production of data products. Customer services, distribution, and all other EOSAT expenses associated with marketing, training, education, promotion, sales, etc. are supported by revenues generated from the sale of data products, and therefore, are not part of the NOAA contract costs.

Question 3. Provide a summary description of the activities carried out by EOSAT with NOAA funding for the years 1985 through 1991.

Answer. Under the terms of the Landsat commercialization contract with the Department of Commerce, EOSAT is responsible for a) the design and fabrication of Landsat 6, b) the operations of Landsats 4 and 5, c) the operations of Landsat 6, and d) the development of the remote sensing market. Items a and b are funded (by the government) elements of the contract, while item c and d are a non-funded obligation of EOSAT.

With respect to item a, the procurement of Landsat 6, EOSAT is the prime contractor, with subcontract arrangements with GE AstroSpace and Hughes SBRC for the spacecraft and instrument, respectively. EOSAT assumed partial financial responsibility for the new Landsat ground segment, with facilities located in Lanham, Maryland and Norman, Oklahoma. The construction of the space segment and of the data processing portion of the new ground segment for Landsat 6 was negotiated at a firm fixed price to the government at \$220 Million, with the provision that EOSAT would return \$10.8 Million to the government from data sales. The final installment, or \$800,000, will be paid by March 1993, resulting in net cost to the government for Landsat 6 of \$209.2 Million.

Landsat operations have been funded by the government from the inception of the EOSAT contract up to September 30, 1992, when EOSAT assumes total financial responsibility for the operations of Landsats 4 and 5. During this period, the cost to the taxpayer for the operations of the Landsat system decreased from \$40 Million to \$20 Million annually. EOSAT is contractually responsible for paying for the operation of Landsat 6 following launch. Government funding to EOSAT for operations covered only costs associated with spacecraft command and control, data reception and preprocessing, and product generation. Beginning October 1, 1992 all these costs will be funded by EOSAT from data sales revenue, thereby relieving this funding expense from the taxpayer.

Development of the remote sensing market was a no cost item to the government. EOSAT in pursuing this objective has invested in excess of \$17 Million to develop the market. In addition, we have made capital investments in the space segment in the form of an additional downlink antenna, enhanced communications capabilities, and alterations necessitated by changing the solar crossing time (a change instigated at the data users request). Also, capital investments have been made by EOSAT in the ground segment in the data capture facility and the new 11 meter antenna located outside Norman, Oklahoma. In fact, the facility and antenna were totally funded from EOSAT non contract revenues. Total EOSAT capital investments for space and ground system hardware are approximately \$20 Million at this time and growing.

Question 4. Provide a comparison of the data sales market projections as presented in the original NOAA/EOSAT contract with those actually realized on a year by year basis from October 1, 1985 through 1991.

[In thousands of dollars]

Categories	1985—4th quarter CY 1985	1986	1987	1988	1989	1990	1991	1992—1st quarter CY 1992
Market Projection Original Contract	\$3,432	\$16,237	\$12,220	\$8,580	¹ \$28,306	¹ \$19,460	¹ \$21,020	¹ \$5,700
Actual Revenue	2,759	15,312	16,966	16,043	18,040	21,655	22,590	4,402

¹ Adjusted per changes required by Mod 19 to the Contract.

Question 5. Starting October 1, 1985 through March 1992, provide the net earnings, by year, of EOSAT as an operating entity resulting from the reimbursement of operating costs by NOAA and the sale of data products and receipt of foreign station access fees and royalties.

[In thousands of dollars]

Categories	1985—4th quarter CY 1985	1986	1987	1988	1989	1990	1991	1992—1st quarter CY 1992
Total Data Sales ¹	\$1,350	\$9,373	\$9,742	\$8,643	\$10,208	\$13,609	\$14,758	\$2,596
Ground Station Fees	1,409	5,939	7,224	7,400	7,832	8,046	7,832	1,809
Operations Revenue ²	1,625	12,070	12,561	11,688	8,498	10,570	11,061	2,298
Landsat 6 Contract	3,051	52,201	12,654	25,408	43,364	39,474	26,976	3,165
Total Revenues	7,435	79,583	42,181	53,139	69,902	71,699	60,627	9,868
Pre-tax Earnings ³	1,591	10,486	11,173	9,468	8,851	8,590	11,007	2,019

¹ Includes sales of miscellaneous items (posters, etc.) from 1987 through March 1992.

² Includes equipment relocation in 1989 and 1990.

³ These nominal earnings are incorporated in the financial statements of the parent companies. Not included above are the EOSAT capital investments in the space and ground station segments, derived from the total revenue shown, nor the additional expenses incurred by the parent companies in developing Landsat 6 in excess of the fixed price contract. In addition, funding, revenue and earnings are expected to be impacted by EOSAT's autonomous operation of Landsat 4, 5, and 6 in the 4th quarter of 1992 and beyond, when the operation revenue ceases, and by the conclusion of the Landsat 6 contract.

QUESTION ASKED BY SENATOR PRESSLER AND ANSWER THERETO BY MR. PECK

Question 1. For the period 1975 to October 1985 when the NOAA/EOSAT contract began, provide the dollar amount of revenue, by year, from the Landsat data sales and foreign station access fees and royalties.

Landsat Revenue

Fiscal year	Landsat sales	Foreign station fees ¹
1975	\$909,009	
1976 (15 months)	2,093,664	
1977	1,453,837	
1978	1,976,068	
1979	2,131,813	
1980	2,388,567	
1981	2,495,268	
1982	2,941,279	
1983	² 8,138,560	4,235,000
1984	² 9,963,223	4,505,000
1985	² 10,976,525	5,877,000

¹ Access fees which were collected by NASA prior to 1983 are not known by the USGS.

² Includes NOAA data acquisition charges of \$4,091,675, \$6,130,275, and \$5,313,905 for FY 1983, 1984, and 1985, respectively.

PREPARED STATEMENT OF DAVID BARTLETT, PRESIDENT, RADIO-TELEVISION NEWS DIRECTORS ASSOCIATION

On behalf of the Radio-Television News Directors Association (RTNDA), I am pleased to submit the following statement for the record of the subcommittee's hearing on S. 2297, to revise the and Remote-Sensing Commercialization Act of 1984.

The Radio-Television News Directors Association is the principal professional organization of journalists who gather and disseminate news and other information on radio and television in the United States.

For several years, RTNDA has sought to create a more favorable regulatory environment in order to encourage private companies to launch and commercially operate new remote-sensing satellites in space. RTNDA seeks greater availability of high resolution earth images for use by the news media to inform the American public, in keeping with the nation's open skies policy and free from unwarranted government interference.

To date the sole focus of S. 2297 has been the government's Landsat program as it has developed under the 1984 Act. That concern is addressed by changes through titles IV and V of S. 2297. RTNDA's area of special concern, as just indicated, is that part of the 1984 Act that pertains to the licensing of private remote-sensing systems, which provisions would be recodified by title III of S. 2297.

The Subcommittee should not neglect the opportunity, through amendments to title III and related provisions of the bill, to correct conceptual mistakes and unconstitutional procedures in existing provisions of the 1984 Act as they apply to privately funded commercial systems, specifically 15 U.S.C. Sections 4241, 4242, 4243 and 4277.

RTNDA seeks changes in federal law that will assure application of First and Fourth Amendment free-press and search-and-seizure-protections for space-based news gathering. The remote-sensing systems now in orbit are not fully suitable for news and information gathering. But future systems may be designed for more timely and higher resolution data acquisition. Changing current federal law will encourage private investment in a "mediasat" or other privately funded company in the business of selling high-resolution imagery to news outlets around the world.

RTNDA has argued that the 1984 Act does not adequately accommodate constitutional requirements and that Commerce Department regulations do not implement the Act in a manner consistent with the Constitution. (See Petition for Rulemaking, filed by RTNDA et al. with the National Oceanic and Atmospheric Administration, April 1, 1988. This pleading has been provided to the Subcommittee staff.) In the Federal Register of January 18, 1989, NOAA rejected most of the proposals. NOAA said then that it would start further rulemaking to address some of the proposals, but it has not done so.

The need for Congressional action in this matter is due in part to the failure of NOAA to do what it could do to improve its own regulations; but, more fundamentally, the need for statutory reform stems largely from the failure of Congress in

Subchapter IV of the Act (Title III of S. 2297) to establish a regulatory structure that clearly mandates the free-press, free-enterprise and open-skies policies of our governmental system.

The current provisions of the Act create a statutory scheme for licensing new commercial remote-sensing satellites to private entities that are willing to accept a status similar to government contractors while assuming the full financial risks of private entrepreneurs. This scheme is not consistent with other government policy, including Presidential directives, which encourage U.S. private industry to develop commercial, free-enterprise applications in space.

Therefore, with respect to both S. 2297 and H.R. 3614, we have proposed amendments designed to (1) create a less forbidding regulatory environment which would be more conducive to private investment for journalistic and other private, commercial imaging purposes, and (2) accommodate vital governmental interests in protecting national security and in meeting international obligations without infringing upon First Amendment and Fourth Amendment rights of private citizens, including journalists.

Several of the amendments proposed by RTNDA were adopted by the House Committee on Science, Space and Technology in H.R. 3614, and we are working to gain floor amendments to that bill in order to fully achieve our goals, which are to

(1) incorporate a standard ("serious and imminent injury" to national security or international obligations) and a procedure (case-by-case court injunctive relief) consistent with traditional First Amendment law;

(2) provide procedures for licensing, suspending and terminating satellite operations in a manner that meets due process requirements, including agency hearings and written findings and conclusions by the agency, with normal judicial review thereof;

(3) eliminate the provisions for administrative searches and seizures;

(4) qualify the nondiscriminatory access requirement to give media-operated satellite companies first use of data; and

(5) retain the current statutory provisions that give the departments of Defense and State advisory rather than determining roles on matters of national security and international obligation, respectively.

Attached are RTNDA's proposed amendments, referenced to existing provisions of Title 15 of the U.S. Code, Sections 4241-43 and 4277. In S. 2297, these provisions are to be substantially recodified through Sections 301-03 and 505.

In addition to all of the changes in these provisions proposed in RTNDA's attached amendments, RTNDA here objects to S. 2297's change from existing law in the first sentence of Section 505 of the bill. As explained in the attached, RTNDA has proposed that the second sentence of that section be changed to make it clear that the Secretary of Defense may recommend but may not make the final decision with respect to remote-sensing matters related to national security. The first sentence should, therefore, retain the Defense Secretary's role as one of consulting rather than taking action.

In the attachment, one rendition of the amendments is through amendatory language with section-by-section explanation. The other rendition is through a text of the entire sections with additional and stricken language indicated appropriately.

These changes are necessary to make the statute properly sensitive to constitutional and commercial concerns of potential private-sector license applicants. Entrepreneurs, including media organizations, could not be expected to invest hundreds of millions of dollars in a business that is still subject to arbitrary and unconstitutional decision-making (including the possibility of outright extinguishment of their investments) under the broad and dangerous powers which the Act bestows upon government regulators.

RTNDA is grateful to the Chairman, members and staff of the Subcommittee for the consideration being given to this matter. We ask that you or your staff contact me or RTNDA General Counsel J. Laurent Scharff, a partner in the firm of Reed Smith Shaw & McClay in Washington, if you desire more information or discussion about RTNDA's concerns and proposals.

PROPOSED AMENDMENTS TO SUBCHAPTER IV AND RELATED PROVISIONS OF THE LAND
REMOTE-SENSING COMMERCIALIZATION ACT OF 1984, 15 U.S.C. 4241 ET SEQ.

1. *Section 4241*—Licensing private sector parties; authority of Secretary; limitation

Amend subsection (b) by

(1) striking the first comma and inserting therein the word "and";

(2) striking the next comma and inserting therein a period; and

(3) striking the remainder of the subsection: "and any applicable international obligations and national security concerns of the United States."

Explanation.—The language to be deleted is too broad an authorization for denial of a license. National security and international obligations are covered more carefully under other provisions of the Act as qualified by these proposals.

2. Section 4242—Licensing requirements for operation

Amend subsection (b) by

(1) deleting the phrase " , at a minimum, " in the opening clause;

(2) deleting in paragraph (1) the phrases "and promote" and "and implement" and the word "section"; and adding the phrase "the Secretary's valid orders pursuant to sections 4243 and" after the phrase "in accordance with";

(3) inserting before the semi-colon at the end of paragraph (2): " , but this paragraph shall not be construed to prohibit a licensee from publishing remote-sensing imagery before making the unenhanced data commercially available promptly thereafter on non-discriminatory terms";

(4) deleting the last phrase in paragraph (3): "satisfactory to the President;" and substituting therefor: "consistent with the provisions of this subchapter, upon the approval of the Secretary;";

(5) inserting after the first three words of paragraph (4) the phrase "at normal charges";

(6) deleting in paragraph (5) the phrase " , obtain advance approval of any intended deviation from such characteristics. "; and

(7) substituting a period for the semi-colon at the end of paragraph (6) and deleting paragraphs (7), (8) and (9) of the subsection.

Explanation.—The "at a minimum" language can be construed as supporting too broad an authority in the Secretary to specify license requirements, while the absence of the language does not preclude other reasonable requirements.

Private licensees may be required to do what is truly necessary to protect national security and to observe international obligations, under orders of the Secretary and the courts, but they cannot constitutionally be required to "promote" national security and "implement" international obligations.

NOAA has adopted a rule permitting a licensee to make first use of data for dissemination or images to the public before promptly making the data available on a non-discriminatory basis; the statute should specifically authorize this practice, which would be important in the case of operation of a satellite by one or more news media entities.

The change in paragraph (3) of the subsection would recognize that termination of satellite operations, which could include transfer to another private entity, is a matter for decision through normal nonpolitical, administrative channels, subject to administrative and constitutional due process protections, and is not a proper subject for presidential fiat.

The government should have no greater right to non-discriminatory access than any other purchaser of remote-sensing data, and hence the clarification in paragraph (4) of the subsection that the secretary may order the unenhanced data "at normal charges".

The ability of the government to recognize threats to national security and seek injunctive relief in the courts (under another proposed amendment here) depends on the government's ability to obtain "complete orbit and data collection characteristics of the system," as called for in the current law. The government would not, however, have a need in that context, or the right under First Amendment law, to require news-collecting organizations to seek advance approval of orbits; hence, the later requirement in the current law is to be deleted.

Paragraphs (7), (8) and (9) of the subsection are antithetical to the concept of a private, free-enterprise information system protected by the First and Fourth Amendments. Other provisions of the Act, as modified by other proposals here, would assure adequate authority in the government to deal with serious threats to national security and international obligations.

3. Section 4243—Administrative authority of the Secretary: review of adverse action on license application; judicial review of final actions

Amend the title of the subsection to add: " , injunctive relief "

Amend subsection (a) by

(1) adding at the end of the opening clause: " , insofar as consistent with applicable law, ";

(2) deleting from paragraph (1) the phrase " , on an immediate basis, ";

(3) deleting paragraph (2);

(4) deleting paragraph (6); and

(5) deleting the period and adding the following at the end of current paragraph (7): “, subject to limiting statutory, constitutional and other evidentiary privileges and rules;”;

(6) adding a new paragraph (6) as follows: “(6) apply to a United States District Court for a temporary restraining order or injunction to prevent serious and imminent injury to a distinct and compelling national security interest of the United States, or to prevent a serious and imminent violation of a valid international treaty obligation of the United States.”

Amend subsection (b) by

(1) deleting “(1), (a)(3), or (a)(6),” following the phrase “pursuant to subsection (a)”;

(2) adding the phrase “, with written findings and conclusions,” after the phrase “on the record”;

(3) adding the word “for” after the phrase “after an opportunity”.

Explanation.—The changes in Section 4243 are proposed to eliminate the pervasive, invasive and unconstitutional supervision and control which the Secretary is empowered to exercise under the Act. Other existing law is to the contrary of this Act's grant of unqualified powers to the Secretary. See, e.g., the Privacy Protection Act of 1980, 42 U.S.C. 2000aa, which is a well-considered policy determination by the Congress to give news gatherers additional protection from searches and seizures. Under the section as amended, the Secretary would be deprived of a power to take “immediate” action in terminating, suspending or further conditioning licenses, because a system of administrative appeal, with decisions based on hearing records and written findings and conclusions, together with judicial review (as well as injunctive relief as proposed here), is preferable policy and is constitutionally required.

4. Section 4277—Consultation

Amend subsection (a), the second sentence, to delete the word “determining” and substitute therefor the word “recommending”.

Amend subsection (b), the second sentence, to delete the word “determining” and substitute therefor the word “recommending”.

Explanation.—The Secretary of Defense and the Secretary of State are understandably to be consulted on matters within their areas of special knowledge. Nevertheless, the Secretary of Commerce, as the person with responsibility for the licensing of private remote sensing systems, should have the ultimate authority for making a balanced decision about the need for specific national security and treaty-required conditions on licenses. The final and comprehensive decision by the Secretary of Commerce, based on reasons stated in writing, will be the decision reviewable by the courts.

PROPOSED SUBCHAPTER IV—LICENSING OF PRIVATE REMOTE-SENSING SPACE SYSTEMS

§ 4241. General authority

(a) Licensing private sector parties; authority of Secretary; limitations

(1) In consultation with other appropriate Federal agencies, the Secretary is authorized to license private sector parties to operate private remote-sensing space systems for such period as the Secretary may specify and in accordance with the provisions of this subchapter.

(2) In the case of a private space system that is used for remote sensing and other purposes, the authority of the Secretary under this subchapter shall be limited only to the remote-sensing operations of such space system.

(b) Grant of license; conditions

No license shall be granted by the Secretary unless the Secretary determines in writing that the applicant will comply with the requirements of this chapter[,] and any regulations issued pursuant to this chapter[,] and any applicable international obligations and national security concerns of the United States.]

(c) Review of applications by Secretary

The Secretary shall review any application and make a determination thereon within one hundred and twenty days of the receipt of such application. If final action has not occurred within such time, the Secretary shall inform the applicant of any pending issues and of actions required to resolve them.

(d) Denial of licenses; Secretary to refrain from denying to protect licensees from competition.

The Secretary shall not deny such license in order to protect any existing licensee from competition.

§ 4242. Licensing requirements for operation

(a) No person who is subject to the jurisdiction or control of the United States may, directly or through any subsidiary or affiliate, operate any private remote-sensing space system without a license pursuant to section 4241 of this title.

(b) Any license issued pursuant to this subchapter shall specify[, at a minimum,] that the licensee shall comply with all of the requirements of this chapter and shall—

(1) operate the system in such manner as to preserve [and promote] the national security of the United States and to observe [and implement] the international obligations of the United States in accordance with *the Secretary's valid orders pursuant to sections 4243 and 4277 of this title*;

(2) make unenhanced data available to all potential users on a non-discriminatory basis, *but this paragraph shall not be construed to prohibit a licensee from publishing remote-sensing imagery before making the unenhanced data commercially available promptly thereafter on non-discriminatory terms*;

(3) upon termination of operations under the license, make disposition of any satellites in space in a manner [satisfactory to the President] *consistent with the provisions of this subchapter, upon the approval of the Secretary*;

(4) promptly make available *at normal charges* all unenhanced data which the Secretary may request pursuant to section 4272 of this title;

(5) furnish the Secretary with complete orbit and data collection characteristics of the system[, obtain advance approval of any intended deviation from such characteristics,] and inform the Secretary immediately of any unintended deviation;

(6) notify the Secretary of any agreement the licensee intends to enter with a foreign nation, entity, or consortium involving foreign nations or entities[.];

[(7) permit the inspection by the Secretary of the licensee's equipment, facilities, and financial records;

[(8) surrender the license and terminate operations upon notification by the Secretary pursuant to section 4243(a)(1) of this title; and

[(9)(A) notify the Secretary of any "value added" activities (as defined by the Secretary by regulation) that will be conducted by the licensee or by a subsidiary or affiliate; and

[(B) if such activities are to be conducted, provide the Secretary with a plan for compliance with the provisions of this chapter concerning non-discriminatory access.]

§ 4243 Administrative authority of the Secretary; review of adverse action on license application; judicial review of final actions; *injunctive relief*

(a) In order to carry out the responsibilities specified in this title, the Secretary may, *insofar as consistent with applicable law*—

(1) grant, terminate, modify, condition, transfer, or suspend licenses under this subchapter, [and upon notification of the licensee may terminate licensed operations on an immediate basis,] if the Secretary determines that the licensee has substantially failed to comply with any provision of this chapter, with any regulation issued under this chapter, with any terms, conditions, or restrictions of such license, or with any international obligations or national security concerns of the United States;

[(2) inspect the equipment, facilities, or financial records of any licensee under this subchapter,]

[(3)](2) provide penalties for noncompliance with the requirements of licenses or regulations issued under this subchapter, including civil penalties not to exceed \$10,000 (each day of operation in violation of such licenses or regulations constituting a separate violation);

[(4)](3) compromise, modify, or remit any such civil penalty;

[(5)](4) issue subpoenas for any materials, documents, or records, or for the attendance and testimony of witnesses for the purpose of conducting a hearing under this section;

[(6) seize any object, record, or report where there is probable cause to believe that such object, record, or report was used, is being used, or is likely to be used in violation of this chapter or the requirements of a license or regulation issued thereunder; and

[(7)](5) make investigations and inquiries and administer to or take from any person an oath, affirmation, or affidavit concerning any matter relating to the enforcement of this chapter, *subject to limiting statutory, constitutional and other evidentiary privileges and rules*; and

(6) *apply to a United States District Court for a temporary restraining order or injunction to prevent serious and imminent injury to a distinct and compelling national security interest of the United States, or to prevent a serious and*

imminent violation of a valid international treaty obligation of the United States.

(b) Any applicant or licensee who makes a timely request for review of an adverse action pursuant to subsection (a)[(1), (a)(3), or (a)(6)], of this section shall be entitled to adjudication by the Secretary on the record, *with written findings and conclusions*, after an opportunity for an agency hearing with respect to such adverse action. Any final action by the Secretary under this subchapter shall be subject to judicial review under chapter 7 of Title 5.

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SUBCHAPTER VI—GENERAL PROVISIONS

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§ 4277. Consultation

(a) Consultation with Secretary of Defense on national security matters

The Secretary shall consult with the Secretary of Defense on all matters under this chapter affecting national security. The Secretary of Defense shall be responsible for *[determining] recommending* those conditions, consistent with this chapter, necessary to meet national security concerns of the United States and for notifying the Secretary promptly of such conditions.

(b) Consultation with Secretary of State on international obligations

(1) The Secretary shall consult with the Secretary of State on all matters under this chapter affecting international obligations. The Secretary of State shall be responsible for *[determining] recommending* those conditions, consistent with this chapter, necessary to meet international obligations and policies of the United States and for notifying the Secretary promptly of such conditions.

(2) Appropriate Federal agencies are authorized and encouraged to provide remote-sensing data, technology, and training to developing nations as a component of programs of international aid.

(3) The Secretary of State shall promptly report to the Secretary any instances outside the United States of discriminatory distribution of data.

(c) Reimbursement of system operators for certain costs

If, as a result of technical modifications imposed on a system operator on the basis of national security concerns, the Secretary, in consultation with the Secretary of Defense or with other Federal agencies, determines that additional costs will be incurred by the system operator, or that past development costs (including the cost of capital) will not be recovered by the system operator, the Secretary may require the agency or agencies requesting such technical modifications to reimburse the system operator for such additional or development costs, but not for anticipated profits. Reimbursement may cover costs associated with required changes in system performance, but not costs ordinarily associated with doing business abroad.

PREPARED STATEMENT OF DR. C. PETER MAGRATH

Mr. Chairman, members of the Subcommittee, my name is Peter Magrath and I serve as the President of the National Association of State Universities and Land-Grant Colleges (NASUGGC). The membership of the Association includes 149 public universities—at least one in every state of the Union. I am honored to submit testimony on their behalf.

The members of NASULGC and I applaud this Subcommittee's effort to review and consider the restructuring of Landsat policy. We certainly are pleased to have this opportunity to express our strong support for the Land Remote Sensing Policy Act of 1992 (S. 2297) that was introduced by Senator Pressler earlier this year.

Agriculture, forestry, fish and wildlife biology, water resources, environmental science, public policy and planning, marine science, and many other segments of the university community are affected by the nation's land remote sensing policy. A marginal-cost policy for Landsat imagery and aerial intelligence would allow researchers at our public research universities to obtain badly needed data in a cost-effective manner for ongoing projects in such areas as: agricultural management and development practices; forest deforestation, degradation, and management issues; water quality and water resources management practices; rural and urban land-use management; pest control; marine resource management; environmental monitoring; fish and wildlife habitat management, protection, and conservation; endangered species monitoring and protection; global change; weather forecasting; energy source locations; and rangeland condition and preservation. For the purposes contained in S. 2297, "marginal cost" should be defined as the cost of reproducing shipping unenhanced data.

To be more specific, this Subcommittee might be interested in how particular institutions are using and would use Landsat data if marginal-cost pricing for such data was enacted. Some institution-specific examples are:

Virginia Polytechnic Institute and State University uses the data to define land cover conditions as a data layer in the Virginia Geographic Information System and in their water quality/nonpoint source pollution modeling programs. The high cost has made Landsat data prohibitive and the institution has been forced to use less expensive alternatives. Marginal-cost pricing would make the data more cost effective and acceptable for VPI's use.

University of Nevada-Reno has been prohibited from utilizing Landsat data because of current costs. However, the University has identified the following as potential uses for the data: crop inventory; identification of critical habitat for protected animal species; identification of land-use impacts, including early warning signals of overutilization, by domestic and wild animals; monitoring the condition of riparian habitat, range and forest vegetation, and the effects of fire and long-term drought; monitoring impacts of urban development on critical habitat; and monitoring capacity and availability of water supplies.

University of Wisconsin-Madison has conducted basic and applied research concerning enhancement and application of Landsat imagery since the inception of the Landsat program. In one single project performed between 1979 and 1981, the University's Environmental Remote Sensing Center (in conjunction with EPA, and the Wisconsin's Department of Natural Resources) purchased 34 Landsat tapes to monitor trophic status of approximately 3,000 of the state's major lakes.

Undertaking similar research at current data prices is simply not economically feasible. Other remote sensing research and education activities at the University include: statewide land-use mapping; soil erosion control planning; water quality determination; urban and rural non-point source pollution control planning; wildlife forage potential and habitat suitability; crop stress detection; agricultural commodity program compliance monitoring; irrigation management systems support; weather-related crop damage; forest stand mapping, forest condition assessment, and significant forest insect problems; soil mapping; National Resources Inventory support; stream flow estimation to support hydrologic structure design; long-term change in natural resource base from regional climate change; mapping superficial geology of the state; image map production; and geographic information systems development and use. The availability of high quality satellite imagery at reasonable prices is critical to the understanding of many agricultural and natural resource issues faced by Wisconsin and the nation.

Mississippi State University currently uses Landsat data for the development of a multistage sampling technique to discriminate pine plantations from natural pine and inventory plantations in the Mid-South region, inventory and monitoring of the Tropical Moist Forest in northern Guatemala, development of a multistage sampling scheme to inventory and monitor forestland within the confined floodplain of the Mississippi River (Cairo, IL to Head-of-Passes, LA), and the development of methodology to facilitate large area natural resources inventory in the Mid-South region. With marginal-cost pricing, the University could use Landsat data in archaeological investigations; environmental impact assessments; continued work in forestry inventory techniques, including the development techniques for assessing multiple-use benefits as part of the forest inventory; and wildlife habitat mapping.

Tennessee State University, providing information on behalf of the research and teaching activities in the agricultural programs of the 1890 land-grant colleges and universities, indicates that Landsat data is used by the 1890 agricultural community in performing basic and applied research in forestry, soil conservation, soil classification and management, crop assessment and monitoring, environmental assessments; and water quality studies involving erosion sediments. In classroom instruction, the 1890 land-grants use Landsat data in these areas: remote sensing of earth surface feature; quantitative approaches to remote sensing; introduction to geographic information systems and spatial analyses; and principles of geographic information systems for land resource assessment. The 1890 land-grant community could expand their utilization of Landsat data into soil management and conservation, landscape planning and design, soil and water pollution, and environmental courses if marginal-cost pricing is enacted.

Once the policy of making data available at marginal costs has become established, the public will be repaid for its large investment in numerous ways. There will be an explosion of new research involving remote sensing data that will produce both scientific and technical advancements in the public interest. The public interest will be served through greater access and use of Landsat's data by a multitude of sources—colleges and universities, all levels of government and their affiliated agencies, farm organizations and individual farmers, environmentalists, small busi-

nesses, and others—for a variety of projects in the national interest. Tax revenues, jobs, and new methods and techniques for interpreting data will be created from the new value-added entrepreneurs that will come forth to apply remote sensing to a host of problems. High schools and universities will set up training programs in remote sensing because of the rising demand, and a growing pool of people trained in the field will be created. Therefore, this policy would stimulate the use of remote sensing data and hasten the day when true commercialization—the private sector building and operating its own equipment—becomes feasible.

S. 2297 correctly realizes that full commercialization of the Landsat program cannot be achieved in the foreseeable future, and this objective should not serve as the near-term goal of national policy. A national policy of nondiscriminatory access to data would be the most beneficial use of land remote sensing data, and data generated from any land remote sensing satellites funded by the United States Government via the generosity of the American taxpayer should be made available to all domestic users at prices that do not exceed the marginal costs of filling a specific user request. This type of national policy has the wholehearted support of NASULGC's membership, and we hope this Subcommittee, along with the entire Senate, endorses the marginal-cost pricing concept when S. 2297 or similar legislation comes before the Senate and when the issue is considered in any conference with the House of Representatives.

The members of NASULGC have other interests in S. 2297 that we would like to see the Subcommittee consider. It is our understanding that other witnesses before this Subcommittee will address these areas, so I do not wish to belabor them. However, I will take this opportunity to indicate our support for the following issues: the need for more and better sensors; mandating measures to ensure that data is delivered to users in a timely and efficient manner; increasing the research, development, and demonstration, remote sensing applications and training in the uses of such applications; establishment of regional university-based technology transfer centers; expansion of the cooperative research and development activities; greater technology transfer including the development of public school curricula; a national land remote sensing data set of all data collected in the United States as well as a global land remote sensing set; appointing a Landsat Advisory Council to ensure that the requirements of the user community are considered in relation to the technical development, processing and dissemination of data, and other matters relevant to the utilization and application of Landsat data; and promoting and encouraging development of an openly competitive private sector value-added remote sensing community.

I am honored to have had the privilege of submitting testimony in relation to S. 2297 on behalf of the members of NASULGC. Thank you.

PREPARED STATEMENT OF WILLIAM P. BISHOP, VICE PRESIDENT FOR RESEARCH,
DESERT RESEARCH INSTITUTE

I am pleased to comment upon the Landsat program and upon S. 2297; the "Land Remote Sensing Policy Act of 1992" which will amend or replace the Land Remote-Sensing Commercialization Act of 1984.

I agree strongly that it is time to change that 1984 Act.

I was the NOAA official charged with "commercializing" Landsat at the time of the passage of the 1984 Act. In that capacity, I testified before this committee on a number of occasions with optimism regarding the "commercialization experiment".

I think it is clear now that the experiment failed. It failed for a number of reasons, and I will elaborate on some of them in my remarks which follow. But let me just note at the outset that it is now my belief that the experiment is concluded and that it did not work. It is time to go on.

I have carefully read both S. 2297 and the bill, H.R. 3614, being marked up in the House Committee on Science, Space and Technology. I most heartily endorse the directions being taken in these two bills.

Of the two I favor the Senate version for one simple reason. It clearly recognizes a new national priority to continue the Landsat program for sound national interests and it does not try to maintain an appearance of commercialization—an attempt that is made in the House version.

I would like to make three simple points—points that are, I believe, largely incorporated in S. 2297. They are:

(1) There is a national imperative (studying global change and national security) that requires Landsat, and an overall national good in having the government support it.

(2) The "commercialization experiment" has failed, we should let it die and proceed now with what needs be done.

(3) The data should be made easily, inexpensively and widely available at the marginal cost of producing and shipping the copies.

Let me elaborate on my rationale for these three points. They are inextricably intertwined. But all the branching arguments I have explored bring me back to the same three points.

Today, as you make clear in the findings and purpose of S. 2297, and as Senator Pressler made clear in his remarks in introducing the bill, there is a strong national (even international) imperative that runs entirely counter to the concept of commercialization. Today, it is imperative that we have all available sources of environmental data collected and used to understand the changes taking place on our planet. Today, Landsat is a major tool for this different type of reconnaissance and study. Today, Landsat is a major component of Global Change Research. The major tenets of S. 2297 (and, I might add, H.R. 3164) recognize that national good. Thus, I fully support your approach to a new Landsat policy and law.

Having stated the above, let me most forcefully encourage you to stick to the course established in S. 2297, to recognize the national need for Landsat as a national system, to cast off any last vestiges of "commercialization", and to make the data as widely and inexpensively available as possible.

I have already testified before the House Committee urging them to not attempt to serve two inherently contradictory missions—studying global change and commercializing Landsat. I suggested that they stick to the new imperative of serving global change research.

I argued that the new national and scientific imperative to acquire and use as much environmental data as possible requires open, easy and inexpensive access by all parties no matter what their motivation. All use of the data for studying our planet will ultimately derive public benefit in understanding. Scientific use of the data will, of course, advance our understanding of global change. Use for commercial motivations or other civic uses will also add understanding—understanding of where resources are located, where urban areas are growing, where human activities can take place, where forests might best be harvested, and so on. All of these things are a part of understanding our planet and how we fit into the larger "natural systems".

I argued that we should make all of the data from Landsat and the upcoming EOS and all other satellites freely and inexpensively available to all users no matter what their affiliation or motivation. We will gain in the long run from that approach.

Allowing the government-funded operator to make an additional profit from the sales of the unenhanced data was consistent with the intent of the 1984 Act. However, the original intent was to plow those profits back into the building of the subsequent Landsat systems. Having made the change to a new rationale for the Landsat program and a new approach to data dissemination, it seems reasonable and to make the data available to all users at the marginal costs of copying and distribution instead of trying to maintain the fiction of "commercialization".

Having urged you to stay your new course, and make the data widely available, I cannot resist reflecting a bit on history on how we got to the situation where we need to change to this new course.

In 1984, commercialization seemed the proper course. At the time of the passage of the 1984 Act, we were all caught up in the attempt to make the system self-sustaining outside the government. The dominant concept was to move those government activities that could survive outside the government out to the private sector.

The roots of this approach go back to the rhetoric surrounding Landsat, from its very inception, that it was aimed at "practical applications" and "commercial" impact. That rhetoric recognized a larger national good only to a small extent and often incidentally. No one had yet invented "global change research". Thus it seemed reasonable, even exciting, to remove Landsat from its government sponsorship and place it in the private sector with an initial "dowry" or "subsidy" (though some of us were forbidden to use the word "subsidy" in the 1984 discussions).

But there were counter themes throughout the history of the "commercialization". Not everyone wanted to continue the program, even under commercialization. Not everyone believed that the program could be commercialized. Let me trace these counter themes briefly, but limit that review to the past decade.

In 1982, the "President's Private Sector Survey on Cost Control" (known as the Grace Commission) reviewed both Landsat and the meteorological satellites. They found a long standing antipathy in OMB to the Landsat program and remarked:

"The Administration, as represented by OMB and the Cabinet Council on Commerce and Trade, has decided that non-defense Government needs for land remote

sensing data are either not critical or can be acquired in some other way. Simply stated, the government neither wants nor needs the civil land remote sensing system."

They also came to their own conclusion regarding cutting costs for the government and recommended an administration policy, by stating:

"Whether or not the governments's attempt to commercialize civil land remote sensing activities is successful, the Government should stick to its plan not to launch any (Landsats) beyond Landsat D."

That Commission specifically recommend commercialization of the data portion of the then current Landsat program. I will come back to that point later.

OMB's position was then, and continued to be, to stop the program immediately. The users and program managers wanted a continued program for the foreseeable future. A possible compromise, mainly offered to temporize, was to buy one more satellite (then called Landsat D prime, which would have become Landsat 6).

The Secretary of Commerce had his own advisors, a "Land Remote Sensing Satellite Advisory Committee", sometimes called the "Halbouty Committee" after its chair, Dr. Michel Halbouty. The President of my Institute, Dr. James Taranik, both served on that Committee and chaired its "Commercialization Working Group".

In a recent conversation he recalled some of that experience and I paraphrase him here:

"The Committee felt it was absolutely essential to get the government out of those elements of land remote sensing that competed with the private sector potential. But it was just as essential for the government to continue constructing, launching and operating the satellites, as no possibility for a self-supporting private system existed.

"The commercial potential, the committee felt, was in the potential for data interpretation and software programs to make the data user friendly. If a transfer to the private sector was mandated by policy or law, the government should pursue a gradual transfer, the committee said. Transition of the Landsat program to an all-industry program might then be completed by the end of the Century.

"The Halbouty committee was offered something it didn't want to do in 1983. David Stockman and OMB had proposed that Landsat be commercialized or killed. The Committee objected to this because they thought it would take at least 10 years to transition from an experimental program to an operational program. The committee findings document this feeling. The original findings said the US should provide the spacecraft and the operational costs, including launching the sensor. The Government should write off these costs in the public good, commercialization should begin with the data after level zero processing to correct for sensor geometry. With the rest, Government should do no value added or processing. All processing from the arrival of the raw data on Earth should be commercial.

"The oil and minerals industry were campaigning hard for Landsat because they wanted the data. So, Stockman interpreted this to mean they should pay for it. He devised a litmus test that if a program had commercial benefit, then industry should pay for it. The problem is they never really gave true commercialization chance. People were really out to kill the program because they were too short sighted to see the long term potential in the value added sector.

"The Halbouty committee never suggested the entire system could pay for itself in a commercial sense. In fact, they protested this notion. OMB really had an agenda to kill the program due to the general belief in the Reagan Administration that government should stay out of the free market place. Stockman used this theory to frame his 1982 budget."

The Halbouty Committee was recommending getting the government out of competition with the private sector in data processing, but recommending continued procurement by the government of satellites and their operation. Furthermore, they recommended that in any policy for Landsat "the first priority is data availability

As the Halbouty Committee envisioned it, the government would contract with a company to build the satellites, operate them, and provide data down through and including unenhanced data. The government would use that data for its won purposes, which in those days were more limited than today. The data would then enter the commercial market place and stimulate the value added companies. The public interest would be served by wide distribution at the cost of reproduction. This was justified because the public was already paying for the system through taxes. The Halbouty Committee recommended this approach in 1982. Their recommendations were ignored at OMB.

By the time of the FY 1983 budget, David Stockman had laid down the ultimatum—commercialize the system or terminate the program. Neither the Department of Commerce (which I joined just a little later) nor the Halbouty Committee

were pleased by this ultimatum, but both worked hard to keep the system going by commercializing it.

The initial agreement within the Administration as understood by the group charged with the commercialization (which I came to head in December of 1983) was that there would be a one-time government cost spread over a few years and that this might be as much as \$500 million. But after that, there would be no more government cost.

By June 1984 two companies had been selected for contract negotiation. Both offered robust systems involving several satellites, new technology to stimulate the market, and a marketing plan to make the enterprise self sustaining. Both cost in the neighborhood of \$500 million, though the source board thought contract negotiations might bring that down somewhat. Both had market projections which we judged to be somewhere between optimistic and wildly unrealistic. But we felt there was a fighting chance over the next ten years for them to succeed, given the large initial subsidy and the improvements in technology.

By July of 1984 Mr. Stockman had reneged on the original understanding of what might be done, and a new cost limit had been negotiated at \$250M. Only one of the bidders, EOSAT, chose to restructure its program to meet that limit, and it did so by dropping a third satellite and all advanced technology. This made the system less robust, and made the market projections unrealistic, and would have made it virtually impossible to make the program self sustainable. We proceeded "betting on the come", hoping that new technology could be added in the future through some other rationale or budget mechanism.

Later that same month, OMB began a series of crippling actions regarding Landsat, a series of actions that has continued for almost a decade. The first was a refusal by OMB to forward a FY 1983 supplemental request that would have allowed the program to move forward quickly to avoid a predicted data gap. This was followed later by an insistence that the contract be limited to only one satellite. Then came refusals to include the program in subsequent President's budgets. Then refusal to include operational costs. And so on. Only Congress kept the program alive.

In short, an already crippled attempt at commercialization was incrementally brought back to the originally suggested compromise position of having the government buy just one more satellite. That satellite is Landsat 6.

Along the way, at the request of Congress, NOAA commissioned three studies of the commercialization of Landsat. These were delivered in 1987. All three agreed with the original assessment of the Halbouty committee, namely that the program could not become self-sustaining for the foreseeable future.

That brings me to today. We can now say that we have tried the "commercialization experiment". But we were unwilling to give it that initial boost that it needed to even have a slim hope of success. Now the imperatives have changed. The government recognizes its own need for Landsat. And we all recognize the national good in having that data for global change research.

S. 2297 is the next logical step in this historical development of the Landsat system. Continuing even a small vestige of "commercialization" no longer makes sense.

This brings me to the question of data pricing or data dissemination. This is, as I have noted, one of the key differences between S. 2297 and the House bill.

When the Landsat program was transferred to NOAA in 1983, OMB required NOAA to recover costs for the operation of the entire Landsat data collection system through the sale of Landsat data. Without any supporting market analysis, the price for the data was arbitrarily increased from \$100 for an image and \$200 for a computer compatible tape (CCT) to \$400 for an MSS image and \$700 for an MSS CCT. OMB required NOAA to sell Landsat-4 Thematic Mapper (TM) data for \$4,400 for a CCT. The impact of these decisions drove the volume for the data products down initially and caused the dollar volume of data sales to decline.

At about the same time, the Grace Commission recommended commercialization of the data output portion of the program with a totally free market approach including discriminatory pricing and exclusive use. They remarked on pricing, as follows:

"[Having] 70 percent of the revenue would provide incentive to raise prices. Falling demand at high prices * * * would keep prices from increasing beyond their value-in-use for key applications.

"It is not inconceivable that prices for particular kinds of data (like those used for oil exploration) would escalate dramatically in a very few months * * *

"It is important to emphasize that the mechanism outlined here might put the price of the raw data out of the reach of several end-use applications."

They justified these otherwise unattractive features of their proposal by the contention that enormous revenues would be generated by the high-priced data and

that such high revenues might attract private firms to invest in a new space system. This was their approach to commercialization.

Since that time, as we all know, the price for a scene has approached \$5000.

As you are hearing from others, this is prohibitive for many users, and a real inhibition on the value added industry. Your other experts have told you or will tell you that current prices are stifling to both research and the very industry the Grace Commission, the Halbouty Committee, the Administration and the Congress set out to stimulate. I take that conclusion on the part of those experts as axiomatic. It certainly matches the predictions of the Grace Commission and what I hear from colleagues.

I said it above, and it bears repeating, all the Landsat data should be made available to all users, no matter what their affiliation or motivation, at the marginal cost of reproduction and shipping. This I interpret to be the intent of S. 2297, and I applaud that intent.

There are two ways to reach that conclusion. One is to listen to the users—the scientists, local governments, state agencies, and business. You are doing that in this record. I urge you to listen well.

The second way is to try a simple financial analysis of the pricing policy in S. 2297 and an alternative with a "two tiered" pricing. One can consider foregoing the income provided by a "two tiered" pricing policy as a stimulus to the value added business. Let me discuss that briefly, then offer a bit of financial arithmetic.

As a stimulus for business, the single tiered pricing policy described in S. 2297 will shift "commercialization" to the portion of the marketplace where all have historically agreed that it has some chance to succeed. The bill will promote growth in the area of software and computer hardware to interpret and use the data and promote growth in the uses themselves.

The commercialization of communication satellites in the 1960s was vastly different than the attempt at commercialization of satellite remote sensing. With telecommunications, no training of the end user is involved. One simply picks up the telephone and dials. More importantly, the market already existed in full maturity. The communications satellites merely offered a better means of meeting the market need. Although satellite remote sensing data is applicable as an interpretive tool in a wide variety of resource management fields, it takes training and computer programs to read and interpret the data. This is the specialty of the "value added firm." That market is still small but growing. It is the market value added market that needs stimulation, not the space segment and not the distribution of the raw data.

Current commercial pricing policy has repressed overall demand, resulting in the stunted development of specialized value added firms. There is little doubt, and you will hear this from others more knowledgeable than I, that the enormous increase in demand for imagery that would accompany a pricing policy based on marginal cost would stimulate an entrepreneurial bloom among numerous value added companies.

Because remote sensing is applicable to all kinds of resource management fields, it would become the centerpiece of the raw material for the burgeoning business of the developing geographic information systems (GIS). State government officials and academics report that satellite data is presently ancillary to GIS because it is too expensive to incorporate.

Since Landsat commercialization policy was made in 1984, the availability and sophistication of personal computers and the software that makes Landsat imagery "user friendly" has improved dramatically. For example, some individuals now take satellite data down directly into their home computers with "home made" antennas. Landsat data can now be analyzed on the lowest level MacIntosh computer. Landsat data is being used in a few states to teach science education, geography and computer literacy to 7th and 8th graders. But the data is still too expensive for the vast majority.

I believe these developments alone could warrant a change in commercialization policy to make the raw data widely available at low cost and stimulate the segment of the market that helps the consumer interpret the data. Needless to say, increased use of remote sensing by business and government will create employment, provide tax revenues, and help to legitimize the commercialization of space.

I felt the need to prove to myself the financial wisdom of the pricing policy that I recommend, and that which is incorporated in S. 2297. To do so, I simply computed the approximate cost to the government of a program using that policy and one using a two-tiered policy. I assumed no change in the current prices for non-government users. I assumed that the next Landsat will cost the same as Landsat 6 (it will be more).

Although I am no accountant or economist, I can do simple arithmetic. I tried many different scenarios changing assumed demands from researchers and "buyers"

based on current or lowered prices. The overall conclusions do not change. The results of my simple arithmetic for a "baseline" scenario using current use rates are shown in the two attached tables.

From these tables, I conclude two things:

First, there will be a cost in lost revenue to someone (I assume the government) of about \$7 million each year for the policy of making the data available at marginal costs.

Second, based on some reasonable assumptions, there will be a comparable return to the government in taxes, giving no net cost for that policy. Admittedly, I expect that there would be a few year delay in realizing that return.

In summary, every avenue of analysis or argument that I have taken has lead me to the same destination. I arrive at the conclusion that the policies articulated in S. 2297 are the correct policies, that we need Landsat for several national purposes, that the attempt to commercialize Landsat is over, and that the national good is best served by making the data available to all users at a single low price.

Table I.—Cost to the Government of Landsat Program, Three Scenarios—Continue Current Commercialization, S. 2297 With Two-Tiered Pricing, S. 2297 With Single Low Price

Cost factor	Assumed basis	Current approach	New, two tiered	New, one low price
Cost of satellite	\$260,000,000			
Satellite lifetime (years)	5			
Cost of satellite per year	52,000,000	52,000,000	52,000,000	52,000,000
Cost of operation	18,000,000		18,000,000	18,000,000
Cost of marketing	4,000,000			
Income from ground stations	8,000,000		—8,000,000	—8,000,000
Data sales to U.S. Government	4,000,000	4,000,000		
To researchers	2,000,000	2,000,000	2,000,000	2,000,000
To private or foreign	8,000,000		—8,000,000	—8,000,000
Net cost to Government		58,000,000	54,000,000	61,000,000

Notes—Negative numbers are income to Government under new policy. Sources—NOAA and Brown speech (for revenues).

Table II.—Effect of Stimulation of Business on Business and Government Revenues

Cumulative computation	Value	Notes and explanation
Government investment	\$7,200,000	Income waived by virtue of single low price.
Stimulation multiplier	9	Dollars generated in business by each dollar used to stimulate.
Business stimulated by investment	64,800,000	
Percent salaries	65	Labor intensive work one initial investment is made.
Salaries stimulated	42,120,000	
Marginal tax rate	15	Very low, these are not minimum wage jobs.
Income tax generated	6,318,000	
Company profitability	8	Profit as percent of sales, may be high for startup companies.
Corporate tax generated	777,600	Assumed same marginal rate as personal.
Total tax generated	7,095,600	

PREPARED STATEMENT OF DR. EARL HOSKINS, TEXAS A&M UNIVERSITY

First, I wish to express my thanks to the subcommittee for holding this hearing and allowing me to enter these comments into the record. The efforts of Senator Pressler, in introducing S. 2297, and Senator Gore, in chairing the hearing, are particularly appreciated. I speak as a user of remotely sensed data in teaching and research since the 1950's and as a manager of geosciences research activities in universities as a department head and dean since the early 1970's. Landsat data have great potential for helping to solve many problems in the geosciences. Unfortunately, since 1985, its use has been drastically reduced in teaching and research be-

cause of its cost. The 1984 Landsat Commercialization Act allowed the contractor, EOSAT, to set the price of a single Landsat image to more than \$4,000. The use of the imagery is simply not cost effective at that price in the university environment. Let me try to explain. Cloud-free coverage of the U.S. and most of the rest of the world was available prior to 1984. If a single "look" at an area were sufficient to solve a research problem, that "look" was available (and still is) at a relatively low cost. The majority of the problems we work on now, however, would require many repetitive "looks" at the same area. Some of these research projects are related to global change studies such as: clear cutting of rain forests, development and drainage of the wetlands areas and progressive desertification due to overgrazing or other improper agriculture practices. These studies and data requirements are well known and I'm sure will be discussed by others as a part of this record. I'd like to direct your attention to a different class of problems in the earth sciences that are basically natural phenomena but which require a response by society. These problems include: coastal erosion due to some combination of sea level change, land subsidence and the effects of severe storms; major landslides which are the result of unusually heavy snow packs coupled with heavy spring rains and sudden thaws perhaps further coupled with development at the top or bottom of the slide area; the effects of flooding in river valleys brought about by unusual weather patterns (El Nino) and then modified by dam construction, agricultural practices and housing/shopping/industrial development in the valleys; and the long term behavior of the natural or assisted reclamation of lands disturbed by mining, volcanoes and forest fires. There are many other examples of problems that we can work on, but all of them have at least two common characteristics. First, they are based on the determination and understanding of some physical process model. That is, we need to understand the physics of what is happening and then test this model against the observations. Only then can we begin to make predictions and recommendations for rational policy decisions. Second, we need to have more than one "look" at the area and we need more than just before and after "looks." We need a data base, not a data glimpse. A Landsat image is a snapshot of the conditions at a particular instant in time. Every May 8 is not the same. We need to begin to do statistics on the data to establish "normal" variability and "normal" response to events. Ideally then we need dozens or even hundreds of repetitive images of the same area. At \$4,000-plus per image it is inconceivable that we would ever be able to do this kind of research.

A second reason for the decline in use of Landsat by university researchers is competition. Spot and AVHRR have been the principal competitors but the Russian, European and Japanese satellites are now entering the fray. Landsat has some very powerful advantages—better spectral resolution than either Spot or AVHRR, and adequate spatial resolution for most geosciences problems. AVHRR is very low in cost, however, and Spot has been marketed very aggressively and effectively. Besides their standard catalog of coverage, the French will take a special image for you of any place Spot covers at whatever sun angle you wish, in stereo pairs, with a very quick turn around on the order. It seems to be a much more service-oriented, customer-friendly organization than is EOSAT.

During this hearing I heard the opinion expressed that the reason that Landsat sales to universities fell off so dramatically after 1984 was not the increase in price but rather it was due to a decrease in federal research support to the universities. I can't speak for all of the university community, but in the case of the College of Geosciences at Texas A&M University that is complete and total nonsense. In the 1985-86 academic year we did about \$35 million of sponsored research. In 1990-91 that number was \$53 million or about a 50 percent increase. There is more research money available to universities now than ever before. The game is certainly different now than it was 5 to 10 years ago in that there are less block grants and more directed or applied contracts, but there is money out there. No university or federal funding agency can reasonably consider buying 100 Landsat images at the current prices, however. The data are simply priced way outside of the research market.

For all of these reasons then we support the passage of S. 2297. Commercialization can and will take place in the value-added segment of the industry as it now does with regard to the National Census figures. If the current pricing policy is continued there is not much point in sending up Landsats 6 and 7 because very few groups will be able to afford the data no matter how potentially useful it would be.

Again, I thank you very much for this opportunity to comment on this very important piece of legislation.

LETTER FROM BETSY GOTBAUM, COMMISSIONER, CITY OF NEW YORK PARKS AND RECREATION

MAY 5, 1992.

Honorable ALBERT GORE, JR.,
U.S. Senate,
Washington, DC 20510

DEAR SENATOR GORE: I am writing in support of S. 2297, restructuring of Landsat policy. Landsat, a satellite based remote sensing system, offers opportunities for long range environmental planning and protection unthinkable ten years ago. Existing technology should now be used to collect and store as much data as possible for current and future use. Analysis tools developed in the next century can then be applied to today's images offering a baseline against which to measure environmental changes.

Unfortunately, Landsat data is unavailable to many of us responsible for environmental policy and management. Local and State governments are taking on an increasing burden as Federal assistance to cities continues to shrink. Under the current pricing structure, Landsat data is simply out of our reach as a planning tool. The at-cost pricing policy for local governments as well as Federal agencies would open new markets for affordable Landsat data as our agency and others invest in Geographical Information Systems (GIS). Making the technology accessible at one low price will certainly increase the use of the system.

Our Natural Resources Group has received a grant to establish a pilot GIS system for natural resource management. The large natural area parks we will be mapping represent all five Boroughs and include: Pelham Bay Park, Bronx; Alley Pond Park, Udalls Cove Preserve, Kissena Park, Queens; Staten Island Greenbelt, Staten Island; and Inwood Hill Park, Manhattan. Our data layers include topography, soils, vegetation, and environmental disturbance. The addition of Landsat images will allow us to monitor environmental changes and the success of our restoration efforts. At current commercial prices, these data are simply not affordable.

We believe that acting on behalf of the tax payers who funded the Landsat program, public agencies should have access to the data without incurring prohibitive additional costs. We appreciate your continuing efforts in the area of environmental protection and count on your support to assist local government efforts for environmental protection.

Sincerely,

BETSY GOTBAUM.

LETTER FROM MARK JAKUBAUSKAS, RESEARCH ASSISTANT, KANSAS APPLIED REMOTE SENSING PROGRAM, THE UNIVERSITY OF KANSAS SPACE TECHNOLOGY CENTER

MAY 8 1992.

Senator ALBERT GORE,
U.S. Senate,
Washington, DC 20510

DEAR SENATOR GORE, Seven years of EOSAT have shown the attempt at commercialization of Landsat data to be a miserable failure. High prices, poor availability, and lengthy delays in delivery have stifled ongoing and potential research and applications projects. Work carried out at the Kansas Applied Remote Sensing (KARS) Program during its 20-year history has demonstrated that Landsat data can be successfully applied to numerous environmental, natural resource, and agricultural problems. However, these projects have never attained an operational status, due in large part to the prohibitive cost of Landsat data. The KARS Program has shown, in project after project, that satellite remotely sensed data can be used for assessment of endangered species habitat, for assessment and targeting of agricultural nonpoint source pollution, and for predicting invasions of noxious weeds, to list but a few.

As a NASA Global Change Research Fellow, I am keenly aware of the important contribution to global change research that can be made by Landsat data. This data is one of the few long-term archived data sets that will allow us to determine changes in our environment, and from these changes, project into the future. However, global change research is only one of the many possible applications for Landsat data. The data must be made available to researchers in nonprofit institutions and governmental entities at all levels for the cost of reproduction.

As a remote sensing professional who has seen projects stillborn because of the prohibitive cost of Landsat data, and has seen the potential of Landsat go unreal-

ized because of restrictive prices and policies, I welcome the current efforts of Senator Pressler to make a long-overdue and greatly needed break from the failure of commercialization. I would be happy to respond in any way to questions you may have.

Sincerely,

MARK JAKUBAUSKAS,
Research Assistant, Kansas Applied Remote Sensing Program.

LETTER FROM JOHN M. PALATIELLO, EXECUTIVE DIRECTOR, MANAGEMENT
ASSOCIATION FOR PRIVATE PHOTOGRAMMETRIC SURVEYORS

MAY 6, 1992.

Senator ALBERT GORE, JR., and SENATOR LARRY PRESSLER,
*U.S. Senate,
Washington, DC 20510*

DEAR SENATORS GORE AND PRESSLER: The Management Association for Private Photogrammetric Surveyors (MAPPS) is a national trade association of private firms in the surveying, mapping and Geographic Information Systems (GIS) data collection and data base development field. Our membership of more than 100 member companies includes firms involved in remote sensing applications, photogrammetry, aerial photography, Global Positioning System (GPS) and conventional surveying, and related professional and technical services that are encompassed in GIS.

We would respectfully request that this statement be entered into the record of your hearing of May 6 on S. 2297 to enable the United States to maintain its leadership in land remote sensing by providing data continuity for the Landsat program, by establishing a new national land remote sensing policy.

In a study completed for the U.S. Department of Commerce pursuant to the and Remote Sensing Commercialization Act, (Study for An Advanced Civil Earth Remote Sensing System, 1988) the Federal Government was ranked as the single largest market for Landsat data, the mapping community was ranked 9th and State and local government was ranked 10th out of 10 markets.

With reductions in the Federal deficit making U.S. Government resources for Landsat data purchases in the future uncertain at best, it is imperative that other markets be developed if Landsat is to succeed. Mapping is one such non-Federal market with strong potential for future Landsat sales. In order for the mapping community to become a stronger Landsat market, two important actions must be taken.

First, as the aforementioned study advocates, it is critical that future Landsat sensors provide a much greater level of resolution. One of the barriers to private sector use of Landsat, particularly for GIS, is that fact that it does not provide imagery at a high enough resolution for large scale base mapping. It is interesting to note that numerous studies find local government to be the largest segment of the GIS market. One the other hand, the aforementioned 1988 Commerce Department remote sensing study listed State and local government last among the 10 potential Landsat markets.

Landsat and Spot imagery will not soon replace conventional aerial photography. Remote sensing data currently does not provide adequate resolution to be the imagery for large scale base mapping, particularly for local government GIS that includes parcel mapping, infrastructure, roads, buildings and other "planimetric" features.

During the coming years, we can expect Landsat and Spot imagery to be fully integrated into GIS and remote sensing will become a standard visual image for GIS. But this will only occur if remote sensing provides data at a resolution from which satellite imagery can replace conventional aerial photography as source data for large scale mapping. As I am sure you are aware, large scale mapping from aerial photography (photogrammetric mapping) is the foundation for local government GIS.

Therefore, we would urge that pending Landsat legislation establish as a goal or standard the provision of future satellites carrying a sensor with the capability of providing data 5 meter resolution or better.

Second, Landsat must develop non-Federal markets, including the mapping community. Aside from the fact that current Landsat data is not of a high enough resolution or accurate, large scale topographic mapping, the reason the private mapping community is not currently a more significant user of Landsat is the fact that the Federal government dominates and unfairly competes with the private sector in this field.

OMB estimates the Federal Government spends \$1 billion annually on surveying and mapping activities. However, in fiscal year 1989 on \$45 million or 4.5 percent was contracted to the private sector. Despite the existence of more than 250 qualified mapping firms in the United States, dozens of Federal agencies do the overwhelming majority of their mapping work in-house, including that which utilizes Landsat.

With the Federal government as the single largest user of Landsat and virtually all Federal mapping work (much of which is smaller scale and more conducive to the use of remote sensing data) performed in-house, it is no wonder the private market for Landsat does not mature.

This Federal domination of mapping activities has a severe impact on Landsat. By maintaining a virtual monopoly on its own mapping work, Federal agencies fail to give private firms opportunities to do business with the Federal government on projects on which Landsat is applied. This not only perpetuates the Federal government as the major Landsat user, but it prevents the private sector from gaining Landsat experience on Federal contracts that could be used to market Landsat-related services to private clients. Moreover, since Federal agencies also do most of the Landsat-related work which AID finances for foreign governments U.S. mapping firms have had an opportunity to export small scale mapping services using Landsat.

Therefore, we would urge that S. 2297 include a provision that creates a program to encourage Federal agencies to contract out mapping services generally and activities utilizing Landsat in particular.

We believe comprehensive Federal effort to increase utilization of the private sector is critically needed. In the meantime, we believe that each individual agency should be required to address this matter.

On a related matter, we would urge that this problem not be compounded by a Landsat pricing policy that provides an unfair advantage to governmental or non-profit entities. We strongly oppose a tiered pricing strategy. Moreover, we believe that legislation that would authorize or encourage the Landsat commercial operator to enter the "value-added" field would be a form of government-sponsored competition. A number of our member firms have entered the value added business. This includes small and women owned firms. By permitting the same firm to provide unenhanced data from the satellite and adding value to that data, will unnecessarily result in the creation of a government-sponsored monopoly in an area that is currently competitive and constantly attracting new market entrants.

We appreciate this opportunity to present our views. If you desire further information or wish to discuss these issues in more detail, please do not hesitate to contact me.

Sincerely,

JOHN M. PALATIELLO,
Executive Director

PREPARED STATEMENT OF DR. DONALD C. RUNDQUIST, PROFESSOR AND DIRECTOR,
CENTER FOR ADVANCED LAND MANAGEMENT INFORMATION TECHNOLOGIES

The University of Nebraska has been active in the area of remote sensing for twenty years. The Nebraska Remote Sensing Center was organized in 1973 under the aegis of the Conservation and Survey Division. The origin of the Center was linked to: 1) the launch of the first Landsat satellite in the same year; and 2) a University Affairs grant from the National Aeronautics and Space Administration (NASA). In 1986, with increased emphasis placed on new technologies related to remote sensing, such as digital image processing, geographic information systems, and automated mapping, the Remote Sensing Center was reconstituted to become the Center for Advanced Land Management Information Technologies (CALMIT).

The early years of the Nebraska Remote Sensing Center were very much tied to the practical application of data from Landsat. The first projects, which involved manual (visual) interpretation of the satellite images, included statewide general land-use mapping, wetlands identification and mapping, monitoring the diffusion of center-pivot irrigation systems in the state, analyzing changes in lake areas, assessing the impacts of range fires, delineating general soil groups, and classifying dunes of the Sand-Hills region according to type. Once computer technologies became available for processing Landsat digital data, other projects evolved including crop classification, monitoring lake-area changes, assessing the effects of wind erosion, analyzing the optical properties of Sand-Hills lakes, and evaluating habitat for various wildlife species. Most of the project activity was done in conjunction with state

and/or federal agencies. Landsat data were integral to the day-to-day operation of the Remote Sensing Center from 1972 to 1984.

The 1984 commercialization of the Landsat program created the subsequent escalation of prices for data and the introduction of uncertainties about the longevity of the program. Nebraska remote-sensing specialists were forced to obtain remotely sensed data from other sources. There was an increased reliance on collection of spectral information from aircraft platforms, a National Oceanic and Atmospheric Administration (NOAA) satellite, and close-range hand-held instrumentation. Projects involving Landsat data diminished to almost nothing after the commercialization.

The purpose of my testimony is to offer my wholehearted, enthusiastic support for S. 2297, the "Pressler bill," which attempts to correct glaring deficiencies in the Land Remote Sensing Act of 1984. The basis for my support can be summarized by identifying the following issues or problem areas:

1) *Cost of Data*—the effect of the current pricing structure, which is totally out of line, is to discourage, not encourage, the use of Landsat data. It is impossible for most university faculty, not to mention high-school teachers, to obtain such data for teaching purposes. Students ask me why I bother to lecture about Landsat in my class when they will not be able to purchase and process the data when they join the workforce. The unrealistic pricing structure for Landsat data is serving to erode science-education efforts and diminishing its scope. This does not bode well for the future of academic training in remote sensing in the U.S. In addition, the high cost of data limits the practical application of Landsat data by resource managers and conservationists.

2) *Uncertainties about Program Longevity*—Several times since the 1964 commercialization, there have been serious doubts about the longevity of the Landsat program. The public was left wondering whether Landsat would survive at all. The result of these uncertainties is, again, for users of remotely sensed data to seek alternative sources. It seemed, at times, that the U.S. was willing to "give away" all the technological developments and monitoring capability that were the hallmark of the 1972-1984 period.

3) *Sensor Capabilities*—The French, on their SPOT satellite, implemented ten-meter spatial (ground) resolution with the first system they launched in 1986. Why does Landsat continue to offer only thirty meters? Such coarse ground resolution eliminates many potential users, for example urban planners.

4) *The Demise of NASA Applications Programs*—With commercialization came the termination of the NASA-sponsored applications programs. The resource managers, conservationists, and academics who were inspired to use Landsat data after creating various applications activities in the late 1970's and early 1980's are now left with no data to use. Potential users of Landsat data have no mechanisms for receiving NASA assistance and guidance for developing applications.

The combined effect of the problems highlighted above is that interest in remote sensing will probably diminish, and that the U.S. is in danger of losing its leadership position in remote sensing while other countries are advancing. The biggest losers are in resources management, environmental protection, and in the educational opportunities to better understand the world around us.

In summary, I would like to go on record as objecting to the current state of affairs with regard to the Landsat program. As a university professor, I object to the high cost of data which eliminates, or at least limits, the potential use of Landsat information in most classrooms in the U.S. and reduces the scope of American science education. As a researcher, I resent the fact that it is difficult, if not impossible, to incorporate Landsat Thematic Mapper data in my projects due to its high cost. As a provider of service and advice to resource managers and conservationists, I object to the current Landsat operation since those that I advise cannot possibly purchase significant amounts of Landsat data for their work, let alone depend on program continuity. As a taxpayer, I object to the system as it currently operates because my tax dollars helped pay for the Landsat platforms which have orbited or are currently orbiting, and I cannot afford to utilize the data. Why should my tax dollar contribute to subsidizing commercial distributors when most users cannot afford the data anyway?

I urge support of S. 2297. We must initiate overhaul of Landsat operations. The current system simply does not work.

LETTER FROM ROBERT E. BARROW, MASTER, NATIONAL GRANGE

APRIL 22, 1992.

The Honorable ALBERT GORE,
U.S. Senate,
Washington, DC 20510

DEAR MR. CHAIRMAN: The National Grange, celebrating 125 years of service to agriculture and rural America, strongly supports S. 2297, the "Landsat Remote Sensing Policy Act of 1992". We support this measure because the "experiment" in commercialization that was established under the Land Remote Sensing commercialization Act of 1984 has failed utterly, and there is no possibility of achieving bona fide commercialization in the foreseeable future. The public's interest urgently requires a new policy that makes the data from Landsat 6 available at a reasonable cost to those who require it.

The approach that is taken in S. 2297—eliminating "commercialization" and establishing a "single track pricing policy"—is far more workable and logical than the complicated procedure that was embodied in the House bill. S. 2297 gains valuable time for conservation efforts by effecting the change being made in data policy when Landsat 6 is launched rather than waiting for five years until Landsat 7 is begun.

We would support the amendments being offered by Satellites for the Environment that are designed to bring additional focus on practical application and to ensure that the bill's intent (to supply Landsat data to all users at marginal cost) is not thwarted by bad administration.

Once a policy of making data available, at marginal cost, to all domestic users and all bona fide researchers throughout the world is in effect, the public will be repaid in numerous ways for its investment.

Viewed over the long term, a policy that stimulates rather than (as at present) represses using remote sensing data is certain to hasten the day when true commercialization, in which the private sector builds and operates its own equipment, is feasible.

We would appreciate this letter being made part of the hearing record on the Landsat program.

Sincerely,

ROBERT E. BARROW,
Master.

PREPARED STATEMENT OF THOMAS C. JORLING, COMMISSIONER, NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Access to marginal-cost data from Landsat remote sensing satellites is critically important to allow for orderly, reasoned social and economic development while ensuring long-term viability of New York State's environment and health of its citizens. At the present time, State agencies have initiated several projects which rely on analyses of Landsat Thematic Mapper data to provide up-to-date, accurate inventories of the spatial extent and variety of natural vegetation and human alterations of the land. Conducting such inventories of our large and diverse State is extremely expensive. The Earth Observation Satellite Company (EOSAT) currently operates the Landsat system and we are required to purchase Landsat data at rates higher than marginal cost. Recognizing that the Landsat program has been developed and implemented at taxpayers' expense, there is no justification to charge taxpayers a second time to fund governmental agency purchases of Landsat data at other than the marginal cost of fulfilling the user request.

While Congress is now considering two Landsat bills for enactment, only one, S. 2297, appears to afford state agency access to marginal-cost unenhanced Landsat data. HR 3614 as amended on April 7, 1992 calls for marginal-cost Landsat data to be provided to the "United States Government and its affiliated users"; all other entities would be charged commercial rates. Unfortunately, state government agencies are not specifically defined as affiliated users. The only part of the definition of "United States Government and its affiliated users" that might be stretched to apply to state agencies is:

"researchers who are financially supported by a United States Government agency for a project which utilizes Landsat data."

In contrast, the language in S. 2297 much more clearly and explicitly allows for marginal-cost access to Landsat data by state governments as well as other entities. New York State fully supports the provisions of S. 2297 regarding marginal-cost access.

Such access to unenhanced Landsat satellite data will ensure more cost-effective performance of critically important resource assessment projects by numerous New York State agencies. Ongoing and potential resource analyses by State agencies which rely on computerized classification and analysis of Landsat Thematic Mapper data include but are not limited to the following applications:

- mapping vegetative communities (Department of Environmental Conservation (DEC));
- mapping land use and land cover for natural resource planning purposes (DEC, Adirondack Park Agency (APA));
- air quality monitoring (DEC, Department of Health (DON));
- classification of land uses (Equalization and Assessment, (E&A));
- monitoring changes in land use over time (E&A);
- determination of vegetation stress (DEC, APA);
- measuring timber acreage (DEC, APA);
- classification of wetlands for updating inventories (DEC, APA);
- mapping and updating significant coastal wildlife habitats (DEC, Department of State (DOS));
- identifying sites for solid waste disposal (DEC);
- analysis of land cover in combination with topographic and wind data for identification of potential wind generating electrical facility sites (E&A, State Energy Office (SEO));
- wildlife habitat suitability analysis (DEC);
- monitoring the impact of human changes in land cover on the availability of fish and wildlife habitat (DEC);
- monitoring timber harvests (DEC);
- determination of agricultural crop acreages (Department of Agriculture and Markets (Ag. & Mkts.));
- estimating crop yields (Ag. & Mkts.);
- mapping and monitoring water pollution (DEC);
- monitoring thermal discharges to waterbodies (DEC, Public Service Commission (PSC));
- evaluation of power plant sites (PSC);
- analysis of potential transmission line routes (PSC);
- revising geological maps (N.Y.S. Museum, DEC);
- determine land use and land cover of watersheds for water quality analysis (DEC).

In addition, New York State also strongly supports and is actively interested in cooperative research and development projects to enhance our ability to monitor the environment as proposed in Title IV of S. 2297. Cooperative ventures of this nature have the strong potential to improve the cost-effectiveness of resource inventories by all government agencies.

Fair marginal costs for government agency purchase of unenhanced Landsat data and cooperative research and development efforts will allow for efficient and cost-effective delivery of numerous programs and services at all levels of government. This is something every taxpayer and citizen expects. New York State strongly supports both provisions and requests that they be retained in the final legislation.

LETTER FROM ANN W. RICHARDS, GOVERNOR, STATE OF TEXAS

MAY 12, 1992.

The Honorable LLOYD BENTSEN,
U.S. Senate,
Washington DC 20510

DEAR SENATOR BENTSEN: I know that the Senate Commerce Committee's Science, Technology and Space Subcommittee, of which you are a member, will be considering S. 2297, Senator Larry Pressler's amendments to the National Land Remote Sensing Policy Act of 1991. I support this bill and urge your support as well.

Several of Texas' State Agencies, including the Water Development Board, General Land Office and Water Commission, have benefited greatly from the use of Landsat data. This is a particularly useful tool in resource management; conservation, and development. Some of the early projects done by these organizations included inventory of reservoirs for dam safety inspection; evaluation of the water resource potential of playa lakes, rapid assessment of the location and extent of impervious cover in urban areas, and inventory of forest lands in east Texas. Additional projects included detection of changes in the extent of wildlife habitats, statewide vegetation mapping, coastal land-use land resource mapping, and identification of critical wetlands.

The amendments contained in the Pressler bill return control and sales of Landsat to NASA, and will make Landsat more accessible for use by federal, state, and local governments, and universities. We need to protect this access, and I appreciate any support you can give as the Subcommittee deliberates.

Sincerely,

ANN W. RICHARDS,
Governor.

LETTER FROM ROBERT SOMERS, PH.D., DIRECTOR, DIVISION OF SOILS, PLANNING AND
RESOURCE INFORMATION, STATE OF SOUTH CAROLINA

APRIL 27, 1992.

The Honorable ERNEST F. HOLLINGS,
U.S. Senate,
Washington, DC 20510-6125

DEAR SENATOR HOLLINGS:

I have enclosed, for your review, a letter addressed to Senator Larry Pressler concerning S. 2297 (i.e., the Land Remote Sensing Policy Act of 1992). This correspondence outlines a consensus of opinion by South Carolina users of satellite imagery.

An ad hoc users group was convened to discuss the virtues of S. 2297 and for all intents and purposes, the demise of HB 3613. I wrote you a letter on February 25, 1992 discussing Land Resources interpretation of HR 3614 and it appears that intense lobbying from EOSAT and industry has rendered the bill useless to nonfederal governmental entities and nonprofit organizations. Therefore, it is imperative that S. 2297 remain relatively intact with a few amendments to more clearly define who receives Landsat data at the cost of reproduction and defines what marginal costs would mean to purchasers of data.

I hope that as Chairman of the Committee on Commerce, Science, and Transportation, you would support S. 2297 and work with other committee members to establish a single track pricing policy and eliminate commercialization of the Landsat Program.

Sincerely,

ROBERT SOMERS, Ph.D.,
Director, Division of Soils, Planning and Resource Information.

JOINT LETTER FROM FRIENDS OF THE EARTH; AMERICAN FORESTRY ASSOCIATION; AMERICAN LIBRARY ASSOCIATION; ENVIRONMENTAL DEFENSE FUND; AMERICAN AGRICULTURAL MOVEMENT; UNIVERSITY OF CALIFORNIA; CONSERVATION INTERNATIONAL; IZAAK WALTON LEAGUE OF AMERICA; NATURAL RESOURCES DEFENSE COUNCIL; NEW YORK ZOOLOGICAL SOCIETY; WILDERNESS SOCIETY; WILDLIFE MANAGEMENT INSTITUTE; SIERRA CLUB; ANIMAL PROTECTION INSTITUTE OF AMERICA; INTERNATIONAL PRIMATE PROTECTION LEAGUE; SOCIETY FOR ANIMAL PROTECTIVE LEGISLATION; WHALE & DOLPHIN CONSERVATION SOCIETY; NATIONAL ASSOCIATION OF COUNTIES; NATIONAL ASSOCIATION OF STATE AND UNIVERSITY LAND GRANT COLLEGES; NATIONAL AUDUBON SOCIETY; NATIONAL CONGRESS OF AMERICAN INDIANS; NATIONAL FARMERS ORGANIZATION; NATIONAL FARMERS UNION; NATIONAL GRANGE; NATIONAL WILDLIFE FEDERATION; NATIONAL PARKS AND CONSERVATION ASSOCIATION; AMERICAN CETACEAN SOCIETY; EARTH ISLAND INSTITUTE; INTERNATIONAL FUND FOR ANIMAL WELFARE; INTERNATIONAL WILDLIFE COALITION; RAINFOREST ACTION NETWORK; AND WORLD SOCIETY FOR THE PROTECTION OF ANIMALS

MAY 4, 1992.

SENATOR AL GORE,
U.S. Senate,
Washington, DC 20510-4202

DEAR SENATOR GORE: The conservation, academic research and natural resource management communities, including state and local units of government, farmers and American Indian tribes have a vital stake in the effort to reform national Landsat policy. We believe that the "experiment" in commercialization established under the Land Remote Sensing Commercialization Act of 1984 has failed utterly, that there is no possibility of achieving bona fide commercialization in the foreseeable future, and that the public interest urgently requires a new policy which makes the Landsat data available at reasonable cost to those who need it. We believe the approach taken by Senator Pressler's bill, S. 2297, of eliminating "commercializa-

tion" and establishing a "single track" pricing policy to be the only fair and workable means of achieving this end. S. 2297 gains valuable time for conservation efforts by effecting the change in data policy when Landsat 6 is launched, rather than waiting for 5 years until Landsat 7 is launched.

Accordingly, Senator Gore, we strongly support the basic thrust and purpose of S. 2297. After consulting with experts across the country, we have developed some minor, but important, amendments designed to bring additional focus on practical application of Landsat data and to ensure that supply of Landsat data to all users at marginal cost is not thwarted by maladministration.

Once a policy of making data available at marginal cost to all domestic users and all bona fide researchers throughout the world comes into effect, the public will be repaid for its investment in numerous ways.

(a) There will be an explosion of new research involving remote sensing data, producing scientific and technical advances in the public interest.

(b) Use of remote sensing by states, counties, American Indian tribes, federal agencies, farm organizations, corporations and even individual farmers and small businessmen will increase rapidly. National and international conservationists will be able to make routine use of remote sensing to monitor deforestation, soil erosion, desertification, loss of wetlands, to inventory wildlife habitat, to help manage parks and protected areas, and for other purposes. This will be very much in the public interest.

(c) There will be a bloom of new value added entrepreneurs, applying remote sensing to a host of natural resources problems. These firms will of course, pay taxes, create employment and additionally benefit the public by developing new methods and techniques for interpreting data.

(d) Universities and high schools will be stimulated by rising demand to set up training programs in remote sensing and Geographic Information Systems, thus creating a growing pool of people trained in the field.

Viewed over the long term, a policy that stimulates, rather than (as at present) represses, use of remote sensing data is sure to hasten the day when true commercialization, in which the private sector builds and operates its own equipment, is feasible.

Following are our suggested amendments, with a brief text explaining the thrust and purpose of each.

DATA PRICING AND DISTRIBUTION

Our primary concern with the language in the bill dealing with pricing policy is that it does not specifically state that users other than "Earth and Global Change Research Scientists" will receive data at marginal cost.

We think that it is absolutely essential in order to prevent administrative or legal misinterpretation of the marginal pricing provision that this be clarified. We also believe that it will be politically useful to specify the entities who may receive the data at marginal cost. Accordingly we urge adoption of amendment to Title 2, Sec 202(a)(1) as follows. Suggested new language is underlined.

Title II Sec 202

Amended—(a)(1) ensures that existing Landsat data and future unenhanced data acquired by the Landsat system are routinely available to Earth and global change research scientists, and, within the United States, to federal, state and local units of government, American Indian tribes, farm and conservation groups and other non-governmental organizations, academic and educational institutions, private value added firms and other public and private users at costs that do not exceed the marginal cost of filling a specific user request.

Current users of EOSAT are often frustrated by errors and delays in filling orders. We suggest amending 202(a)(2) to help ensure that this kind of situation does not continue.

Amended—(2) considers the reasonable and legitimate requirements of all segments of the satellite land remote sensing user community for access to completely unenhanced data and ensures that measures are taken to ensure that data is delivered in a timely and efficient manner, and that up to date magnetic media are used.

Finally, in order to ensure a uniform interpretation of the term "marginal cost" we suggest defining it in the bill with a new Sec 104(8).

Title 1, Sec 104(8)

New—(8) The term "marginal cost" means the cost of reproducing and shipping unenhanced data.

TRANSFER APPLICATIONS TECHNOLOGY

We consider it essential to stress the practical applications which benefit users across the length and breadth of our country. The following amendments, including language designed to establish Regional Centers, are designed to enhance the applications and technology transfer focus of the bill:

Title I, Sec 102

Amended—(2) Provide for 2 comprehensive civilian program of research, development and demonstration to enhance US capabilities for remote sensing from space to increase, develop and enhance remote sensing applications in the public interest, and to encourage and support training in the use of such applications.

Title I Sec 103

New—(5) To increase, develop and enhance satellite remote sensing applications in the public interest, and to encourage an support training in the use of such applications.

Title I Sec 104

New—(9) The term "Regional Center" refers to a network of university and NASA center-based Landsat applications and technology transfer facilities. These regional centers of excellence shall possess the necessary staff expertise and experience in Landsat applications, and shall be designated and funded to foster the development and implementation of projects based on use of Landsat data, and to assist in the development of Landsat technology training programs and public school curricula. Research and technology transfer programs shall be coordinated through NASA and the Landsat Advisory Council.

Sec 201(b)

*Amended—(3) prepare and submit * * * systems development, and operations, data archiving and dissemination, the establishment of regional university and NASA center based-technology transfer centers (Regional Centers) and commercial considerations. * * **

Title IV Sec 401

Amended—(a)(2)(C) conduct such research and development in cooperation with other Federal Agencies and with public and private research entities (including private industry, agriculture, universities, and public school systems, State and local governments, American Indian tribes, U.S. non-governmental organizations, foreign governments and international organizations) and enter into arrangements (including joint ventures) which will foster such cooperation.

*Amended—(b)(1) * * * Secretary of Energy and the Secretary of Education are encouraged to conduct programs of research and development in the application of remote sensing and to assist in Landsat applications and technology transfer, including development of public school curricula, using funds appropriated for such purposes.*

Amended—(2) Such programs may include basic research at universities, demonstrations of applications, and cooperative activities involving other government agencies, state and local units of government, American Indian tribes, U.S. non-governmental organizations, private sector parties, and foreign and international organizations.

EARTH SCIENCES AND APPLICATIONS

There is concern within the very large U.S. community of Landsat users and potential users who are not global change scientists, (but who are, nonetheless, involved in essential tasks) that their needs are being ignored in favor of global change researchers. We suggest that Title 5, Sec 501(b) be amended to create a national remote sensing data set as well as a global set, and that Title 2 be amended to establish a Landsat Advisory Council.

Title V Sec 501

*Amended—(b) * * * shall provide for long-term storage, maintenance and up-grading of a national land remote sensing data set of all data collected of the United States and a global land remote sensing set (hereinafter referred to as the basic data sets).*

New—201(c) LANDSAT ADVISORY COUNCIL—A Landsat Advisory Council shall be appointed by the Administrator, in consultation with the Secretary, as a means of ensuring that the view and requirements of the user community with respect to technical development, the processing and dissemination of data and other

matters relevant to Landsat applications are known and considered by U.S. government decision makers. The Landsat Advisory Council will have representation from all identifiable user groups including state and local governments, academic researchers, educators, nongovernmental organizations, farmers, American Indian tribes, the private sector value added community and other private sector users. The LAC shall conduct an annual review of the Landsat program and shall transmit its report to Congress, the National Space Council, the Administrator and the Secretaries of Defense and Interior. The report shall contain recommendations for program modifications necessary to gain maximum public value through application of Landsat data and measures necessary to maintain U.S. leadership in land remote sensing.

VALUE ADDED COMMUNITY

We feel that the approach adopted under the 1984 Commercialization Act has repressed and stultified the development of a vibrant and creative value added community. The acceptance of an amendment in the House committee markup designed to subsidize EOSAT's entry into the value added field threatens to make matters even worse. We are, accordingly, proposing language to help insure that private value added specialists have a "level playing field" and are not faced with subsidized corporate competition.

Title I, Sec 102

Amended—(5) To promote and encourage development of an openly competitive private sector value added remote sensing community and to promote, and not preclude, other private sector opportunities in civil satellite remote sensing.

LANDSAT 4 AND 5

Amended—E. There is user concern that Landsat 4 and 5 might be unnecessarily and prematurely turned off, thus interrupting data continuity. We suggest an amendment to Title II, Sec 201(2).

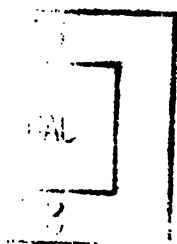
Sec 201(a)(2)

** * * continued operation of Landsat 4 and 5 for the duration of their useful lives.*
Respectfully yours,

BRENT BLACKWELDER,
Vice President for Policy, Friends of the Earth.

[Part V, Office of Management and Budget, Federal Register, Wednesday, April 29, 1992, may be found in the committee's files.]

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